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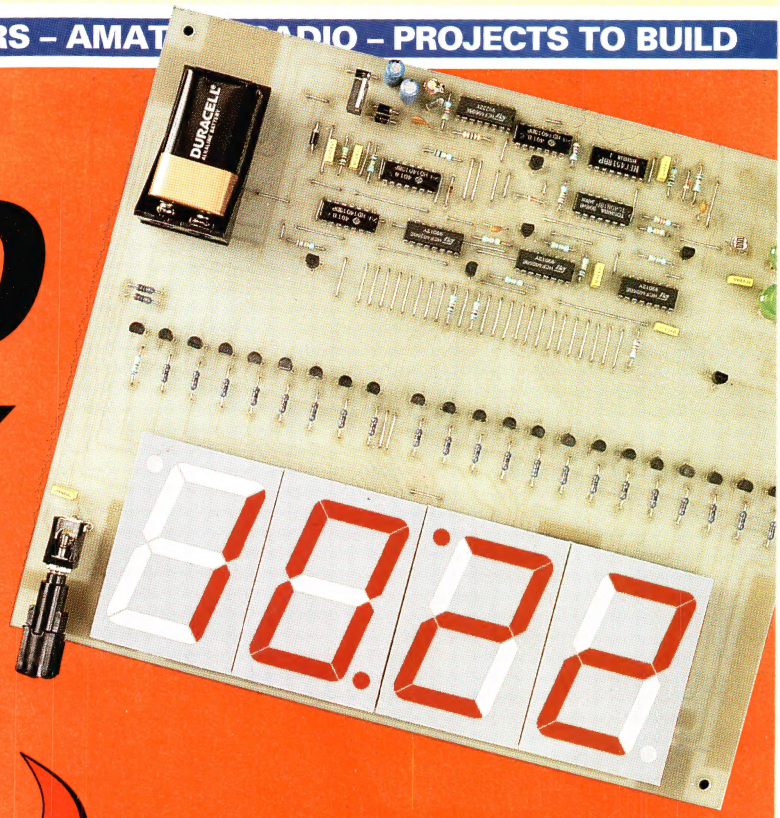

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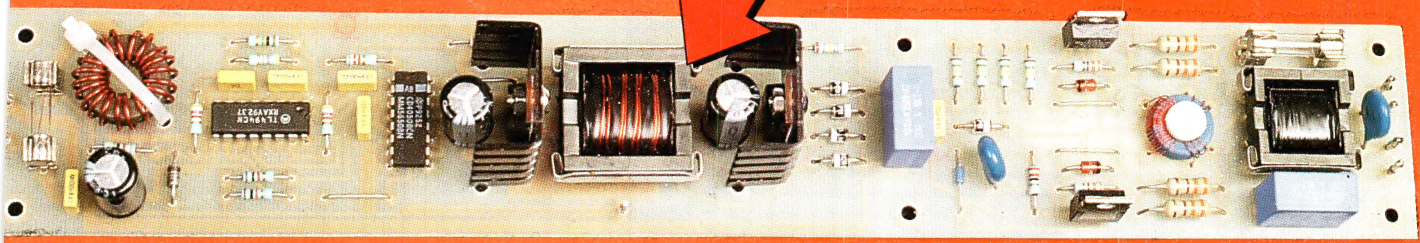

- Siren Sound Generator: Fire, Police & Ambulance
- Building The Stereo Preamp With IR Remote Control
- Review: Tektronix TDS 544A Colour Oscilloscope

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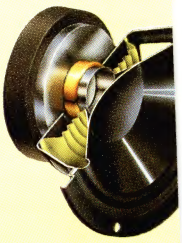
Most loudspeakers today are square. Not because it is a good idea to design a loudspeaker that way, but because it is easy and simple to manufacture. But when performance is more important than economics, it is clear that other shapes should be explored to avoid the common problem of standing waves (echoes) inside the cabinet.

Jamo of Denmark has for years been pioneering alternative shaped loudspeakers with great success; witness the Jamo ORIEL flagship just released after 3 years of intensive research and development. Whilst hi-fi reviewers and enthusiasts alike are in awe of this outstanding loudspeaker, its price tag of $17,000 precludes its use in too many hi-fi systems.

With the know-how gained during the development of the ORIEL, Jamo has now released a new range of loudspeakers directly related to the ORIEL:

The -07 SERIES.

The two floorstanding models in this range, 507 and 707, have curved side panels like the ORIEL to eliminate standing waves. The front firing dual bass/midrange drivers are based on a new patent where the rubbe pension is vulcanized to the inje moulded PP-diaphragm. The result is an outstandingly natural and uncoloured midrange reproduction.



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Why it is better not to be square

Jamo

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SILICON CHIP

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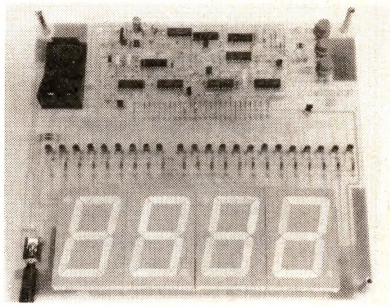
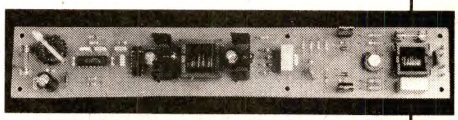
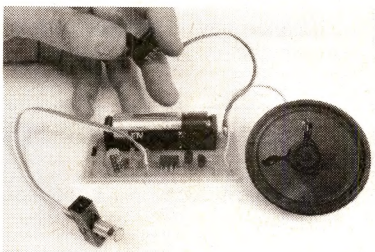


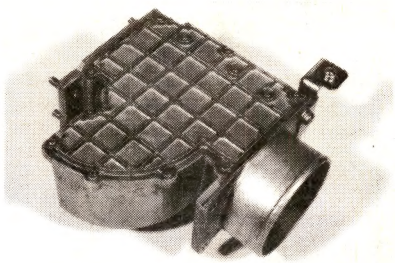
THIS JUMBO CLOCK uses giant-sized (70mm-high) LED displays & has battery backup, AM/PM indication & automatic display dimming at night. Find out how it works & how to build it by turning to page 16.



BOASTING AN EFFICIENCY of better than 80%, this inverter circuit is designed to operate either 18/20W or 36/40W fluorescent tubes from a 12V battery. Construction starts on page 26.



THIS SIMPLE PROJECT uses just one IC & a couple of transistors to generate three siren sounds: police, fire engine & ambulance. It is powered from a single 1.5V cell & is ideal for games & models – see page 64.



AIRFLOW MEASUREMENT is an important function in electronic engine measurement. In Pt.2 of our series this month, we discuss the various types of airflow sensors – details page 4.

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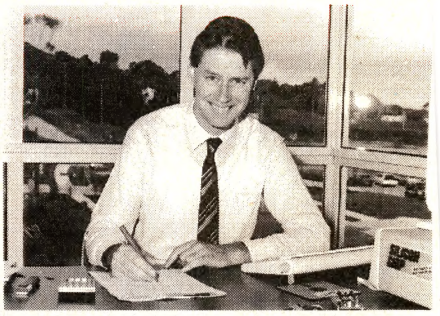
PUBLISHER'S LETTER

The Australian Very Fast Train



We have been pleased to read that the Australian fast train proposal is about to get another run and has been given support by the Federal Minister for Industry, Mr Griffiths. Let us hope that the new consortium, called Spreedrail, does not get bogged down as did the original VFT proposal. It soured because the consortium members were apparently more concerned with being able to profit from land development along the VFT corridor than with the economics of the proposal itself. If similar attempts are made to gain special tax treatment for this new proposal then it deserves to fail again.

Apart from that, it seems as though the public do support the concept of an Australian fast train. It would greatly speed traffic between our capital cities and would be an overall plus for the environment, especially when compared with an equivalent expansion of aviation and road transport. The initial $2.4 billion proposal is for a link between Sydney and Canberra with a travelling time of just over an hour. Then the system would be extended to Brisbane, Melbourne and Adelaide, in that order.

There is no doubt that the fast train proposal is technically feasible. It is to be based on the proven and very successful French TGV and the Speedrail consortium is headed by GEC Alsthom which manufactures the TGV. So the technical expertise is there, both Australian and overseas-based.

The big problem will be in getting the system off the ground and with a minimum of government involvement, although that is probably a vain hope. And once the project is under way, all parties involved will need to devise methods of running it which will circumvent the many inefficiencies which bedevil our existing rail transport systems – a 100+ year old legacy of state government insularity and selfishness, hidebound bureaucracies and unions who are concerned only about survival. If the old ways of working are allowed into the fast train system, it will be a financial disaster.

This need not be so. Australians have an excellent record for bringing large projects to completion on time and under budget and then running them as efficiently as anywhere in the world. Our large mineral projects are enough evidence of that. Let us hope that this excellence is brought to bear in the Australian fast train project.

Leo Simpson

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

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MAILBAG

Making PC boards with a photocopier

After reading a letter on making PC boards with a photocopier in the May 1993 issue, I resolved to give it a go. Here are a few comments on my efforts.

I followed closely the procedure in the letter. Unfortunately for me, only about 40% of the toner transferred from the plastic to the copper. So I varied the idea a little by using an iron (clothes) and a technique similar to that used for iron-on patches or tee-shirt transfers.

Make a photocopy of the circuit design onto a piece of special thermal photocopier plastic (component side, so invert most magazine diagrams). Put something flat and rigid onto the ironing board (to stop movement), then on top of that put the blank PC board (copper side up) and put the plastic transparency on top of the copper. Put a piece of material over the plastic to act as a pressure pad and so the plastic doesn't melt onto the iron. With the iron at its hottest temperature, iron away!

Stop ironing when the material starts to tinge. Carefully take the PC board with the transparency still attached and dip it into cold water to cool it down. Peel the transparency off the board. Hopefully there will be nothing much on the transparency and some nice black tracks on the copper. You will definitely need your etch resistant pen to touch up though. I have had about 80% transference. Now just put the board into the ferric chloride and let it etch.

During the ironing process, make sure the transparency doesn't slide about or you will smear the tracks all over the place. Use a firm pressure on the iron. If a few more people experiment with this idea, perhaps someone will find a compound that can go in between the plastic and the copper and facilitate the toner transfer.

On another subject, what do you do with old ferric chloride? I would like to dispose of it in a fashion that has least impact. A look through the Newcastle Yellow Pages in the waste disposal section and a few phone calls to some of the listed waste disposalists didn't help much.

D. Burke,
North Lambton, NSW.

Comment: We agree that the disposal of spent ferric chloride is a problem and perhaps the best approach is to contact your local municipal council. They generally can accept it, either on particular clean-up days at designated depots, or you may be able to hand in a sealed container at your local tip.

Error in battery status monitor

The circuit in Circuit Notebook, page 16 of the July 1993 issue of SILICON CHIP looks very useful. However, in this item Mr Ritson refers to "the 560Ω resistor" but fails to show one in his circuit. Nor is there a 560Ω resistor in the original circuit in the March 1990 issue.

I would be grateful if you would insert a correction in the magazine.

A. J. Lowe,
Bardon, Qld.

Comment: the line common with pin 16 of IC1 should go to +Vcc, then all the LEDs are connected to +Vcc via a common 560Ω resistor.

Live & dead chassis

It has come to our notice that the Serviceman article in the October 1993 issue of SILICON CHIP has made a mistake in the identification of the following TV sets: National Panasonic models TC-48P10 and TC-1480A. The Serviceman states that both these models are the M15D chassis, when in actual fact they are both M15L chassis. As he explains, "D" for dead and "L" for live – could be disastrous.

We are in the business of producing a fault finder library, as our advertisement in your magazines states. Our sources are the national office in Brisbane and Hi Country Service Data, Cooma, NSW.

Keith Jakins,
Technical Applications,
Kenmore, Qld.

Comment: the Serviceman has admitted his mistake on page 34 of this issue. It came about partly because he tests and repairs all sets using an isolation transformer.

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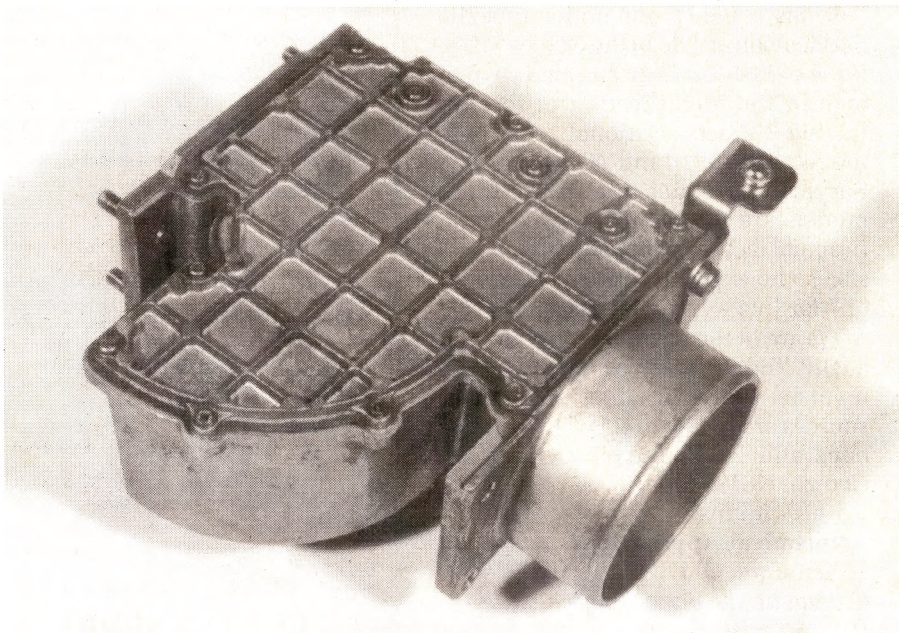
Electronic Engine Management

Pt.2: Airflow Measurement – *by Julian Edgar*

One of the fundamental parameters which an electronic engine management system must sense is the mass of air passing into the engine. If the Electronic Control Module (ECM) cannot measure airflow, then the amount of fuel that must be added cannot be determined.

Use of engine revs (rpm) is insufficient, because the engine may be on the over-run – for example, when driving down a hill with a closed throttle. Even using the throttle position switch (which senses throttle plate opening) in conjunction with rpm is not sufficient to provide accurate airflow data, because actual engine load will not be indicated.

Instead, airflow monitoring is carried out by a specific device designed to measure either air mass flow or air volume flow in conjunction with air temperature. Other systems look the manifold vacuum (or boost) a calculate the airflow indirectly fro this variable.



The vane-type airflow meter is common in early engine management systems & is still currently fitted to some engines. The damping chamber is the curved extension in the foreground.

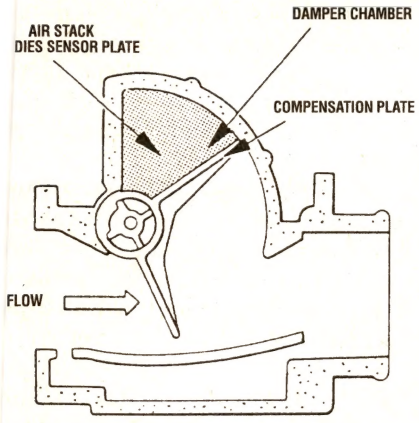
Vane airflow meters

The vane airflow meter is one of t oldest airflow sensors employed engine management systems. Deve oped by Bosch (as almost all engi management technology has been), t vane airflow meter is common on e gines made from about the mid 197 to the present.

The vane airflow sensor (Fig.1) co sists of a pivoting flap, which obstruct the engine's combustion airflow whe the engine is not running. Once th engine starts, a low air pressure i experienced on the upstream side o the vane, causing the flap to open small distance.

As the throttle is opened further the flap is deflected to greater an greater openings. To prevent the fla from overshooting its 'true' position another flap is connected at right-angles to it. This secondary vane works against a closed chamber of air, thus damping the motion of the primary sensing flap.

Mechanically connected to the pivoting assembly is a potentiometer, usually comprising a series of carbon resistor segments. As the vane opens in response to airflow, the wiper arm of the potentiometer moves across the



g.1: a vane type airflow meter. A otentiometer connected to the voting vane assembly is used to ary the output voltage from the eter in response to air flow.

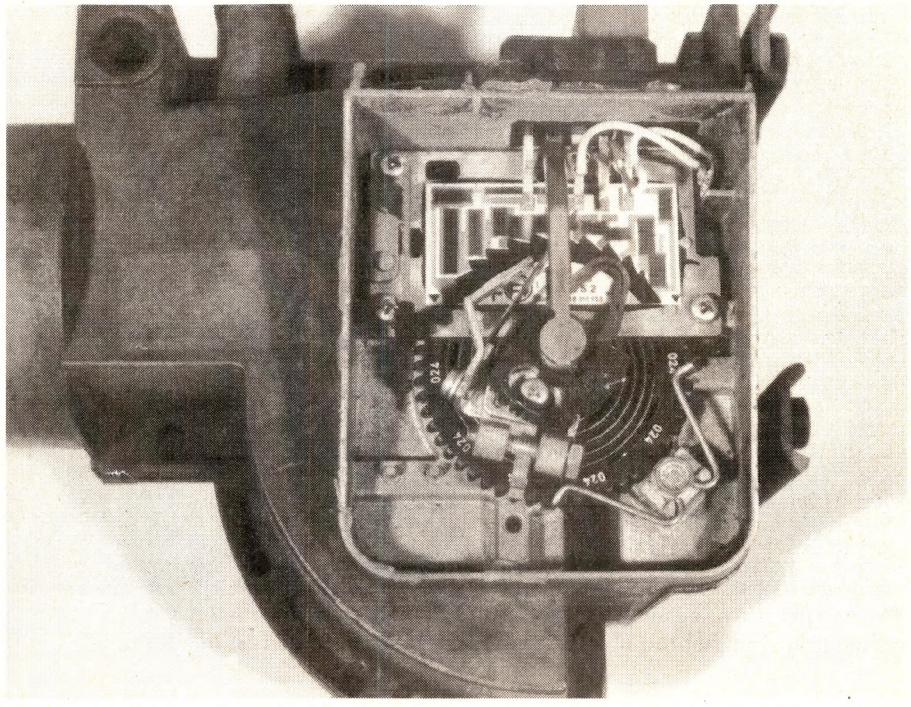
egments, changing the resistance. A egulated voltage is fed to the airflow neter and so, as the vane moves in esponse to airflow variations, the utput voltage from the meter also hanges.

A spiral spring with an adjustable preload is used to relate the angle of he flap to the airflow and to ensure hat the flap closes when no airflow is present. A bypass is also constructed around the measuring flap. Air movement through this bypass passage is controlled by an adjustable screw, giving control over idle mixture.

A vane-type airflow meter measures just the volume of air passing through it, rather than the air's mass. It's the mass of the air which is important in determining the appropriate amount of fuel to be added, however. Because the temperature of the combustion air affects its density, temperature sensing is therefore also built into the airflow meter.

Temperature sensing of the airflow is carried out using a thermistor which is located within the main body of the airflow meter. Typical resistance values for this sensor are 2-3kΩ at 20°C, falling to 0.1-0.4kΩ at 60°C.

In practice, vane-type airflow meters will operate well for long periods of time. The exception to this is if they experience an engine backfire. This shouldn't happen in a properly tuned engine-managed car but is a possible scenario when carrying out EFI modifications or running on LPG. A backfire will often slam the vane shut with such force that it distorts the aluminium casting, subsequently causing binding when the flap is deflected by the airflow. When operating properly, the flap should move through its full travel with only light finger pressure.



This view shows what's inside the base of a vane-type airflow meter. The carbon resistor segments are clearly visible (the black rectangles), while below it the spiral spring can be seen inside the tension pre-load wheel.

Hot-wire airflow meters

The major disadvantages of the vane-type airflow meter are that it senses air volume instead of mass and it restricts the airflow, both because of the need to displace the moving flap and because the cross-sectional area of the flow-path is generally small to increase flow velocity.

The next Bosch invention – the hot-wire airflow meter – overcomes these disadvantages. Used in engines built

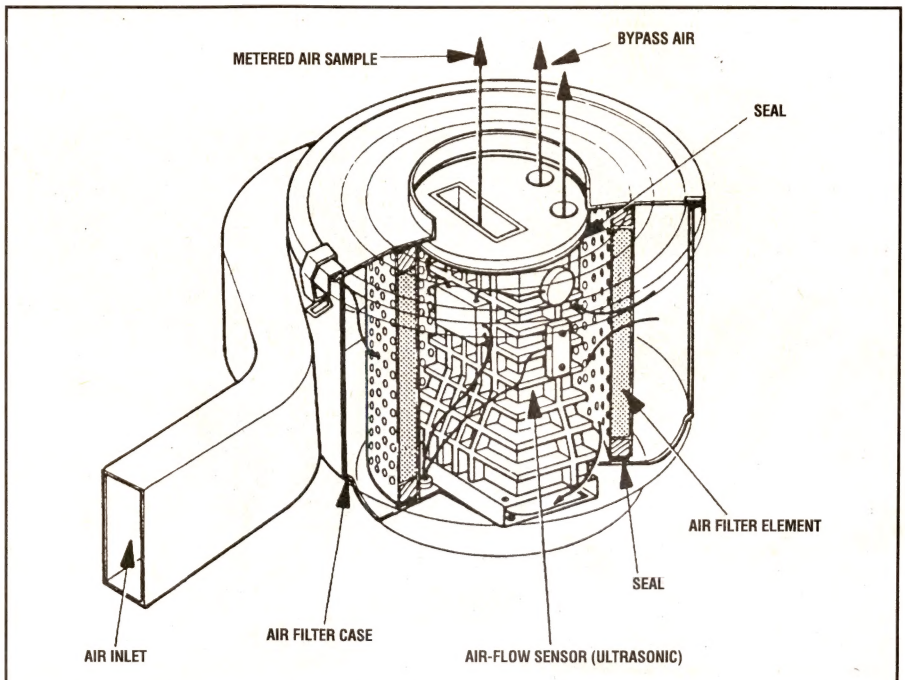
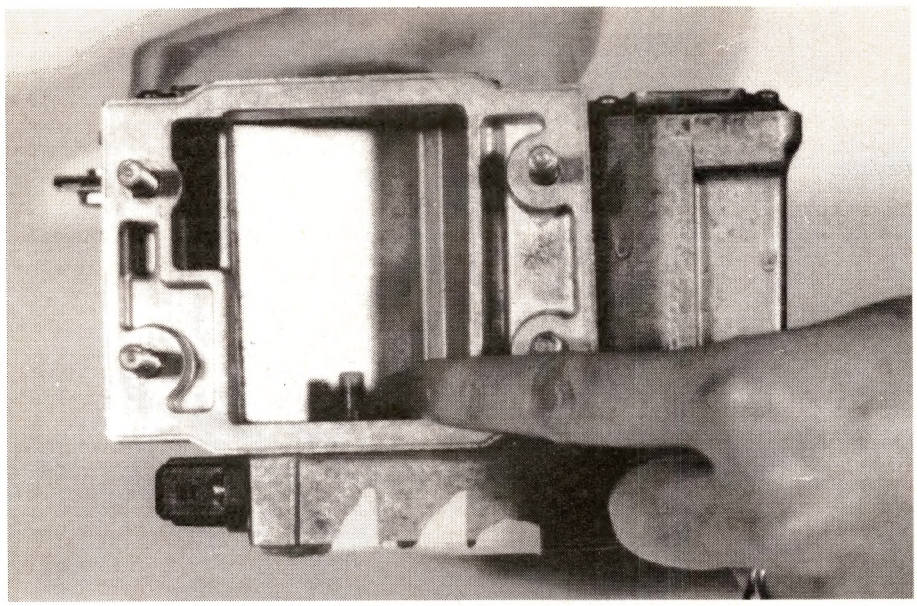


Fig.2: basic construction of an ultrasonic airflow sensor (Mitsubishi).



The temperature sensor is at the front of the vane airflow meter. The rectangular flap behind it is the vane, shown here in the rest position.

from about 1985 to present, it's the most common type of airflow sensor currently used.

The hot-wire (or mass sensing) airflow meter uses a Wheatstone bridge circuit – see Fig.4. A very thin (0.07 mm) platinum wire is formed into a triangular shape and is suspended within the combustion airflow. The platinum wire forms one arm of the bridge and is maintained at a constant temperature.

As the mass of air passing the wire increases, the wire is cooled and its resistance drops. The heating current now immediately increases in response to the bridge becoming unbalanced and returns the wire to its original temperature, thus restoring the balance. The greater the heating current required, the greater the voltage drop across a resistor which is in series with the platinum wire. The voltage drop across this resistor is therefore related to the rate of airflow into the engine.

Very quick response – in the region of milliseconds – is gained using this system. Because resonant pulsing is a potential problem in the airflow measurement of reciprocating engines, t very fast reaction time is important platinum-film resistor is used for te perature compensation, with qui reaction from this device also need for accuracy.

To make sure that the platinum w remains clean, it is heated to red-h for one second each time the engine switched off. This action burns (any dirt or other contamination whi may have settled on the wire.

A potentiometer is placed with the bridge circuit to allow idle mi ture variations to be set. In some a plications, the platinum wire is r placed with a hot-film resistor.

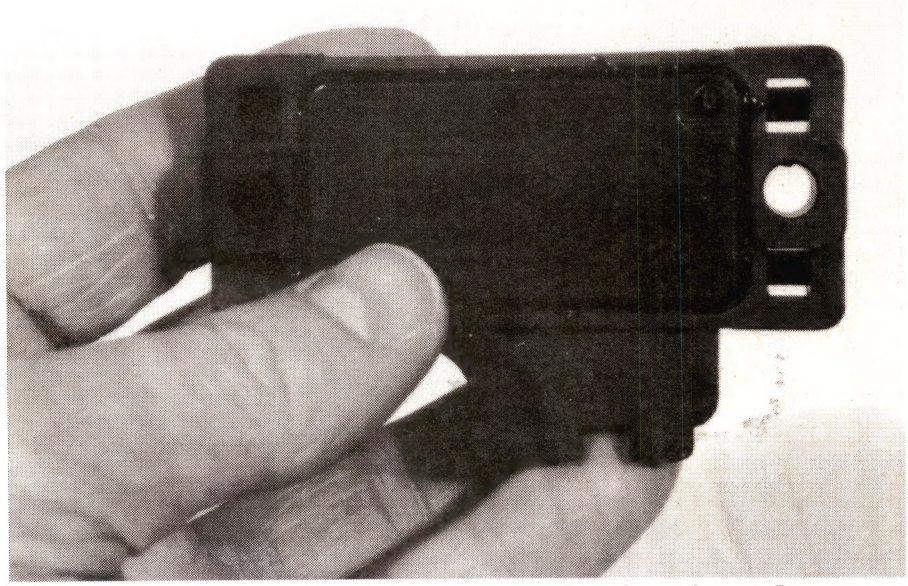
Hot wire airflow meters should la for ever under normal operating co ditions. Physical interaction with th platinum wire will cause damage an so screens are placed at each end (the meter by the manufacturer. A mas sive backfire will also destroy th meter. I've seen one totally wrecke with a huge nitrous-oxide and turb induced explosion!

Karman Vortex meters

Used solely in Mitsubishi vehicles the Karman Vortex airflow mete (Fig.2) is also one of the few engin management devices not invented by Bosch!

In this type of airflow meter, vorti ces are generated in the air as it flows past vortex generators. The frequency of these vortices is related to the volume of air passing through the meter. Ultrasonic waves are used to measure the frequency of the generated vortices. These are propagated at right angles to the airflow and are detected by an ultrasonic receiver located on the other side of the tube. Various receivers, amplifiers and pulse shapers are then used to give an output signal which is interpreted by the ECM.

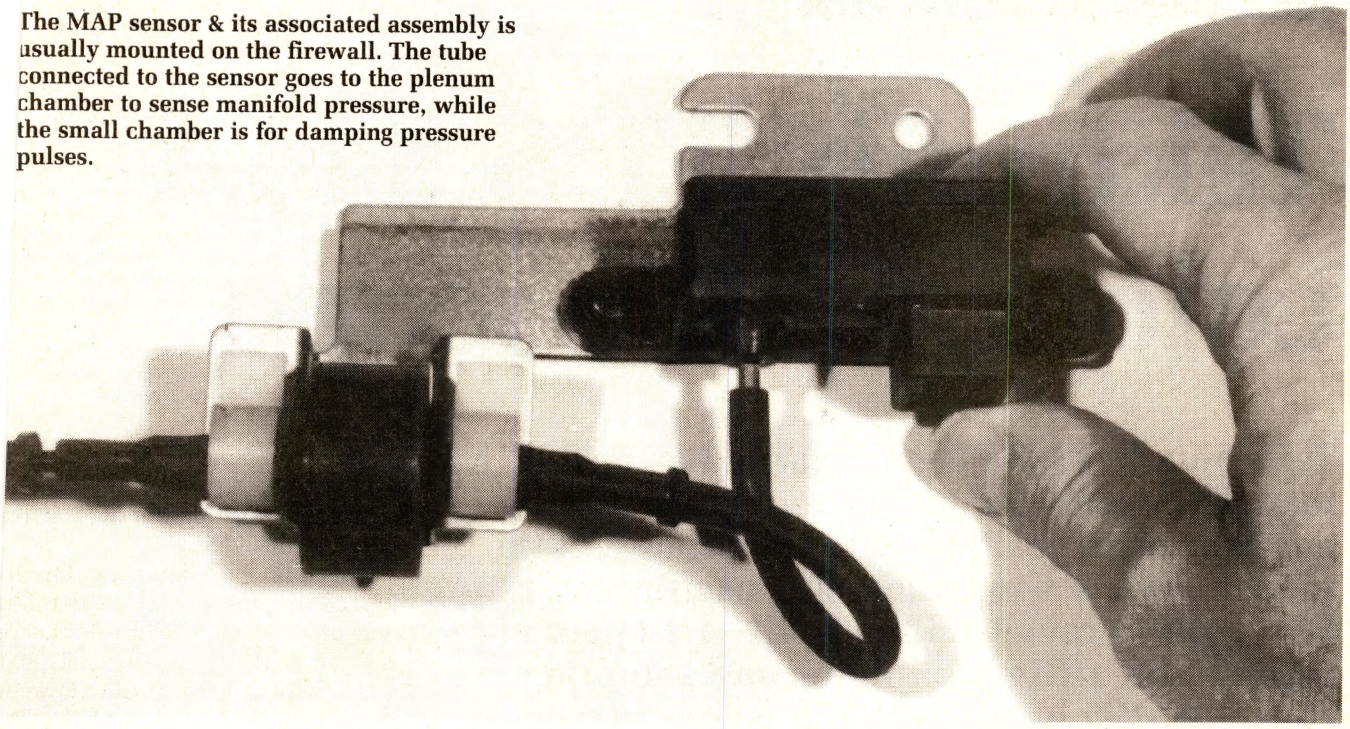
For performance applications (on turbo Mitsubishis, for example) the meter can be replaced by a rewritten software program within the ECM. This can be done because the airflow meter is utilised by the ECM only at low throttle angles.



Manifold Absolute Pressure (MAP) sensing is used in place of an airflow meter is some systems & has the advantage of not causing any restriction to intake airflow. This photo shows a Holden MAP sensor.

MAP sensor

A manifold absolute pressure (MAP) sensor can also be used to derive airflow. When the throttle valve is near shut with the engine running, a high negative pressure is present in the manifold (or plenum chamber as it



The MAP sensor & its associated assembly is usually mounted on the firewall. The tube connected to the sensor goes to the plenum chamber to sense manifold pressure, while the small chamber is for damping pressure pulses.

more usually is in an EFI car). As the throttle opening increases, the pressure approaches atmospheric and, in a turbo car, the manifold pressure can then go on to become positive. Thus, the manifold pressure will have a direct relationship with the combustion airflow.

MAP sensors work in one of two different ways: (1) either as a variable capacitor with the plates being moved closer together under greater air pressures, or (2) as a strain gauge which forms part of a Wheatstone bridge.

While MAP-sensing tends to be used more on simple engine management systems (like single point injection systems), all of the programmable aftermarket injection systems (Autronic, Motec, etc) also use this approach to airflow sensing. Top racing cars – like the current Group A Touring Cars – are therefore using MAP sensing in conjunction with throttle opening and rpm to sense load.

One convincing argument for MAP sensing is that, when the throttle is quickly opened, the ECM can start supplying more fuel and/or different ignition advance before the engine rpm (and therefore airflow) starts to rise. In other words, ECM reaction to quick changes can be faster.

Because the MAP sensor derives its pressure sensing from a small-bore tube connecting it to the plenum chamber, sensing airflow in this indirect manner causes no restriction on intake airflow. A mixture of hardware and software is now available which allows the replacement of restrictive vane airflow meters with a MAP sensor. This is especially useful in high performance, naturally aspirated engines.

That's all for this month. In Pt.3 of this series, we will take a look at how an engine management system can be modified by changing the software in the main memory chip. **SC**

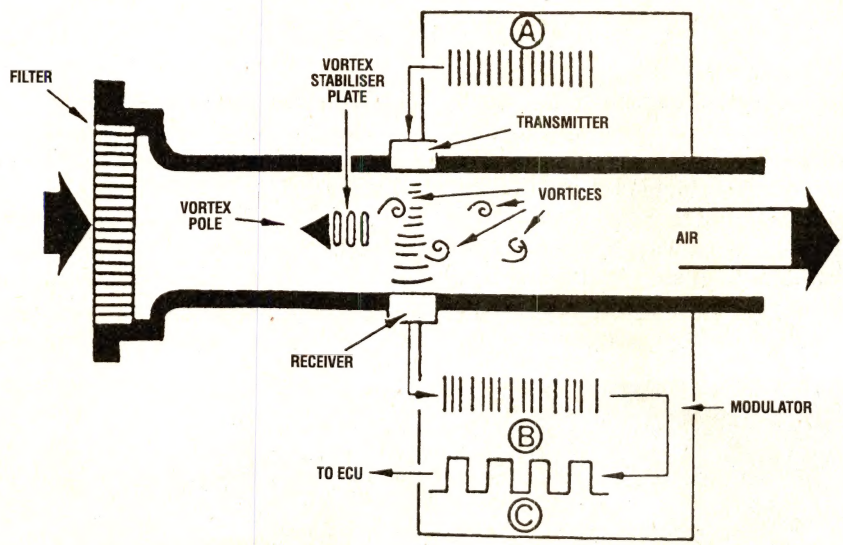


Fig.3: an ultrasonic airflow meter works by measuring the frequency of the vortices generated as the air flows past a vortex pole.

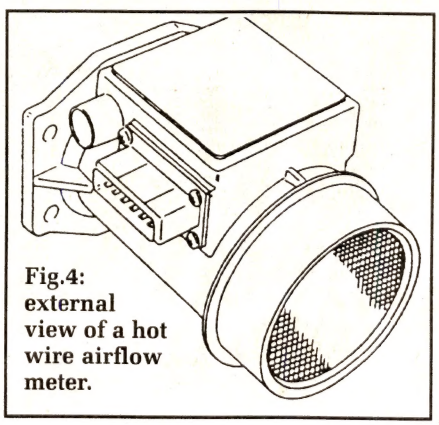


Fig.4: external view of a hot wire airflow meter.

Tektronix TDS 544A colour oscilloscope

Tektronix has long been regarded as one of the leaders in oscilloscope technology & it has confirmed its position with the release of the model 544A & 644A digitising oscilloscopes. We recently reviewed the 544A, a 4-channel model with 1 Gigasample/second sampling rate, 500MHz bandwidth & a colour screen.

By LEO SIMPSON

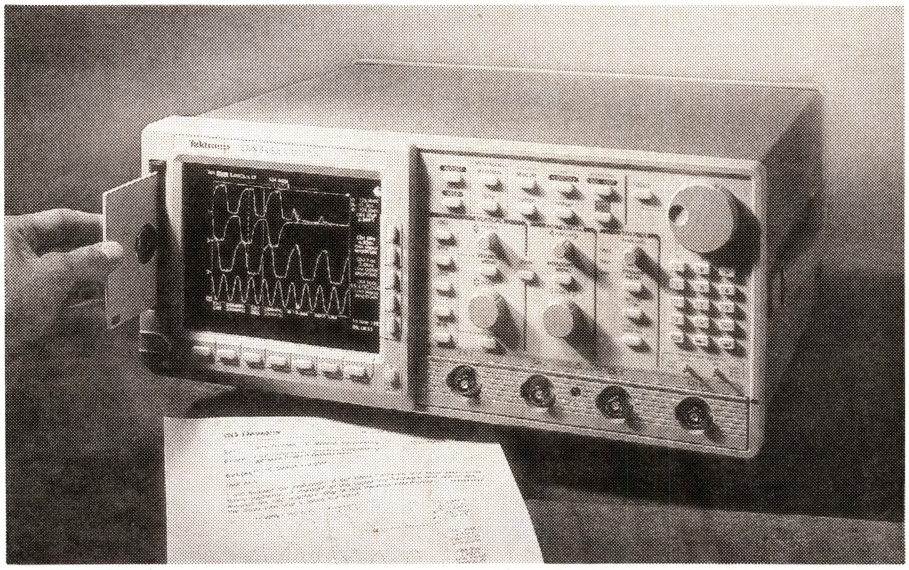
New developments in digital scopes continue to come thick and fast but with the release of these colour scopes, Tektronix has changed the whole ball game. Just as colour has made a huge difference to the way in which we use computers then so it will be with oscilloscopes, particularly multi-channel models which display so much information on the screen.

That really sums up the reason for having colour. If you are using a scope mainly just to display one or two channels and you don't use a lot of the on-screen measurement capability of a modern digital scope, then you probably don't need colour. But if you are displaying two or more channels plus a lot of on-screen information a perhaps even with FFT (spectr analysis), then colour can make world of difference.

Consider for a moment the sit tion if you are displaying two cha nels on a typical CRT readout sco As well as the traces themselves, t scope will usually display the ver cal attenuator settings for both cha nels, timebase settings (main & d layed) and possibly also the trigg conditions. Possibly you will also ha horizontal and vertical cursors ar that usually implies voltage or tin measurements too. And if you sele other measurements as well, th screen can end up being a mass confusion, particularly if some of th digital information is over-writing th traces.

In a normal scope, the only way t reduce the confusion is to get rid o the digital on-screen information bu with the Tektronix colour scopes yo don't have to. Not only is each char nel trace displayed in a different co our but the digital information rel evant to each channel is displayed i the same colour as the relevant trace This makes an enormous differenc in interpreting what is going on.

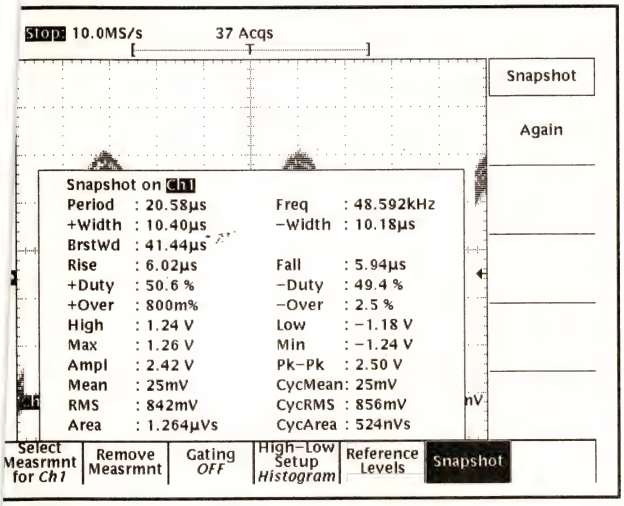
Colour also lets you overlap trace and still be easily able to distinguish between them. This can be really help ful when you have pulse waveforms that are almost impossible to distin guish when the traces overlap.



The Tektronix TDS 544A is a 4-channel 500MHz oscilloscope with a 1 Gigasample/second sampling rate. The addition of the colour display makes a dramatic difference to the way in which information can be shown on the screen.

How the colour is added

While the addition of colour to an oscilloscope may seem a radical enough feature in itself, the way in which it has been incorporated to these new scopes is even more radical. If you have read any of our reviews of the new digital scopes in the



g.1: this is a screen showing the Snapshot – monstrating all the automatic measurements possible cept for phase & delay (with respect to another annel). These measurements apply to the 48kHz sine aveform shown in Fig.2.

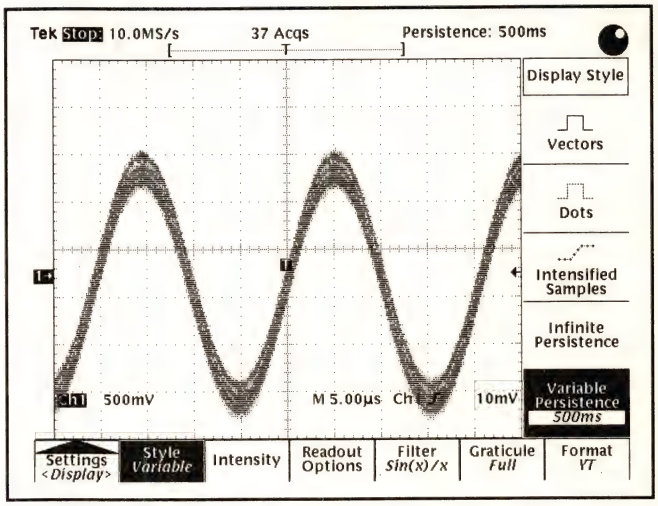


Fig.2: this is the waveform referred to in Fig.1 but shown with variable persistence. This is depicted as a spectral colour display with red showing the most frequently occurring parts of the waveform. Other colour persistence palettes are available, including greyscale.

st two years or so, you will already ıow that most of these do not use a ɔnventional cathode ray tube with ectrostatic deflection and PDA (post eflection acceleration) for fast writ-ıg speeds.

Nor do digital storage scopes use xpensive storage CRTs. Instead, all ıe analog signals fed to the channel ıputs are sampled and converted to ligital values. After that they are con-erted to be displayed on a raster-canned CRT (cathode ray tube) in :xactly the same way as on a compu-er monitor. In fact, some digital scopes :an be connected to a VGA computer nonitor to take advantage of a larger screen size.

So you could be forgiven for think-ing that Tektronix has incorporated colour into these new scopes by em-ploying the equivalent of a VGA col-our screen and whatever electronics are required to drive it. But you would be wrong. The Tektronix TDS 544A (and 644A) does in fact employ a monochrome raster scanned CRT but the colour is added by a liquid crystal shutter in front of the screen. The CRT provides the video or luminance information while the LC shutter pro-vides the colour. This is quite a differ-ent approach to that used by, say, LCD video projectors such as the Sanyo PLC-200P reviewed in the March 1993 issue of SILICON CHIP. Those units use a metal halide projector lamp, dichroic mirrors and three LCD panels to pro-vide the red, green and blue pixel information.

In these new scopes, they use the Tektronix patented Nucolor liquid crystal shutter. The shutter is an elec-trically switchable colour filter made up of two fast liquid crystal optical switches known as "pi cells" plus a combination of colour and neutral polarising filters. A colour screen is produced by having the CRT sequentially produce the red, blue and green video information on the screen while the LC shutter is switched to transmit red, blue and green respec-tively. Alternate video fields, viewed through the switched coloured filters, thereby create full colour images with a maximum of 256 colours.

In more detail, a video frame for the Tektronix LC shutter has three fields – red, green and blue. The frame rate is 60Hz while the field rate is 180Hz. The horizontal scan rate is 91kHz.

LC shutter advantages

The advantages over a conventional triad or vertical slot shadow mask CRT include higher screen resolution, much greater contrast (up to 100:1), no convergence or purity problems and high colour saturation. In addi-tion, the system is more rugged than a shadow mask tube. Of course, this is not the first time that liquid crystal shutters have been used to produced different coloured traces on a scope (Tektronix did it several years ago) but the Nucolour system is greatly refined and produces a much higher contrast than was achieved previously.

If colour was the only new feature of the TDS 544A it would be most worthy of review but this scope is loaded with features that will make other scope manufacturers sit up and take notice and these are in addition to the awesome sampling rate of 1 gigasample/second or the resulting bandwidth of 500MHz. It is a full 4-channel scope with sensitivity adjust-ment available on each channel, from 1mV/div to 10V/div (or 10mV to 100V/div with 10:1 probes). Vertical sensi-tivity can be adjusted in the usual 1,2,5,10 sequence or continuously, using the Finescale softkey.

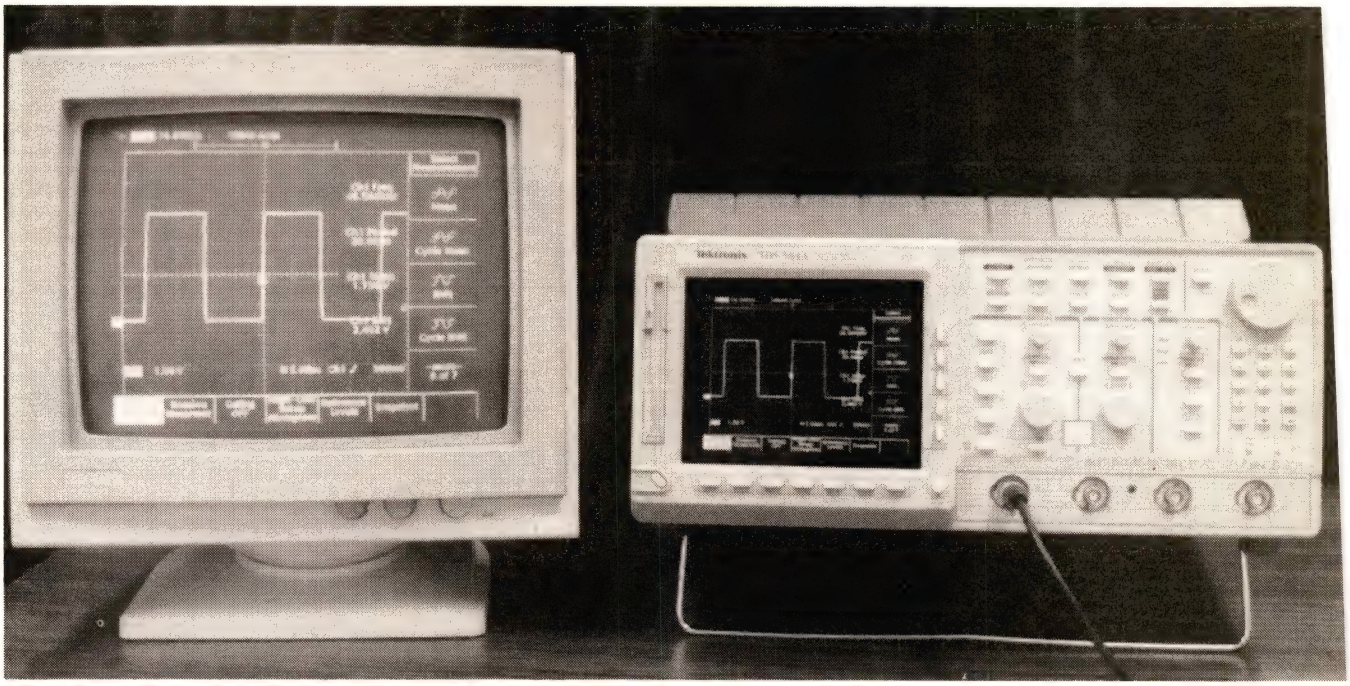
The timebase is impressive, vari-able from 10 seconds/div to 500 picoseconds/div. That is a range of 2 to 10^{10}! Vertical accuracy is quoted as ±1% while timebase accuracy is an incredible ±.0025%.

While some recent digital scopes have tended to be smaller and lighter than their analog cousins, this new model from Tektronix is fairly bulky and heavy. Its overall dimensions are 420mm wide, 195mm high and 415mm deep. It weighs about 12.3kg, depending on options.

The screen size is 140 x 115mm, although the active screen is some-what smaller than this. The scope has a very large fan on the side of the case and yes, it is fairly noisy although it is hard to see how that can be reduced. After all, the case is absolutely chock-a-block with electronics.

User interface

One very attractive feature is the



This photo shows the Tektronix TDS 544A scope connected to a VGA monitor. While the reproduction may not fully show the difference, the scope display is much sharper & has much better contrast.

user interface, the system of menus and softkeys which make a complex instrument such as this easy to use. Without the system of softkeys (12 keys, below and to the left of the screen) it would have been impossible to provide all the functions which are available. Tektronix has improved on the system which is used in the TDS 320 model (reviewed in the July 1993 issue of SILICON CHIP) by adding help screens for just about every function. These are displayed (white text on a blue screen) in much the same way as the help screens for the better software packages.

So if you're lost in the labyrinth of automatic test functions, just hit the HELP button followed by the function button you're about to use and the screen pops up with an explanation. What a revelation!

Triggering from everything

Also very fancy is the selection of triggering functions you can have, particularly as far as video waveforms are concerned. The basic trigger choice is between edge triggering, logic triggering, pulse triggering or video triggering and as you might expect with an instrument of this calibre you can trigger on video line in a frame. Video formats supported are PAL, NTSC, SECAM and HDTV (including Japanese, US and European formats) but if you want something else such as CGA, VGA or something more exotic you just select FLEXFORMAT with one of the softkeys at the bottom of the screen. You can then program in the parameters of the video format you want: sync pulses, frame rate, number of fields, number of lines and so on. Thus, the TDS 544A can cover any video format, even those that have yet to be thought of.

You can also trigger off any line in a video frame, using the numeric keypad or the select knob.

Nor is the comprehensive video triggering necessarily the highlight of the seemingly dozens of triggering options. If you select pulse triggering, for example, you then decide to nominate the width of pulses to trigger on or ignore and you can also select glitch or "runt" triggering. Many readers will be familiar with glitch triggering and the TDS 544A can be programmed to specify the width and polarity (negative, positive or both) to accept or reject. The TDS 544A can trigger on glitches as short as two nanoseconds.

Runt triggering

So what is "runt" triggering? A runt is a pulse which is not up to scratch. Say you have pulse train in a circuit with an amplitude of 6V but every now and again the circuit fails to operate properly. You suspect it may be due to a pulse of insufficient ampl tude but with an ordinary scope th is all you can do – have your susp cions. With the TDS 544A, you ca program it to look for the runt! You d this by programming in the thresl olds which can be positive or nega tive. How can runts occur? One poss bility is from an AND gate where tw or more inputs change simultaneously

Finally, the TDS 544A has logic trig gering whereby it can trigger on logi state (high or low, or for logic condi tions which you define). For exam ple, you could select an AND condi tion for the four input channels anc the scope would then trigger on a true or false condition, again selected by you. You can also select for OR, NOR and NAND conditions.

Measurement options

As with many other digital scopes these days, the TDS 544A provides for a wealth of automatic measurement functions which can be brought into play by pressing the softkeys. Parameters such as frequency, period, risetime, fall time, duty cycle and so on are routine. All you need is a stable waveform and the relevant part of the waveform displayed. For example, the scope will not reliably measure frequency unless you have at least one cycle of the waveform displayed. And if it cannot measure the parameter reliably, it will tell you.

But with so many measurement possibilities it can be a real pain try-

to select the measurement you want, remembering you can do these measurements for any or all of the r channels. Tektronix has thought of that and by ssing the Snapshot softkey you can bring up all measments which are possible for a channel, except for ay and phase. The screen shot of Fig.1 demonstrates s together with the relevant waveform in Fig.2.

ıriable persistence

Among the many options for display is one called ariable persistence". This is used to accumulate wave-m dots which appear and disappear over time accord-ş to a decay constant which you can select. This can be eful for displaying the way in which a waveform varies er time. However, in this case the colour of the wave-rm varies depending on its frequency of occurrence.

To explain this further, a typical sine waveform with ıperimposed noise will have a statistical mean wave-rm exactly corresponding to a sinewave but with devia-ons due to the noise. In effect, with variable persistence ıe waveform will "thicken up" due to the noise. How-ver, on the TDS 544A the variable persistence is por-ayed as a variation in colour from the most frequently ccurring parts of the waveform to those that seldom ppear. Thus, depending on the persistence time, you an readily see the effects of random noise, glitches and o on.

Nor do you have to settle for one type of colour for ariable persistence; you can have three colour palettes. The first of these is "Temperature" whereby the most often occurring waveform is in red ranging down to blue or the least. Or you can have a "Spectral" palette, whereby violet portrays the most common parts of the waveform ranging to red for the least. Or the third possibility is 'Gray Scale" with white for the most down to light grey for the least.

Waveforms displayed in variable persistence mode cannot be saved, as one of the Help screens points out, but you can save a printout – see Fig.2.

Output options

Today's high end digital scopes cannot be regarded as complete unless they have comprehensive facilities for hard copy of waveforms and the ability to be part of a data acquisition system. To this end, the TDS 544A has a Centronics parallel interface (via DB25 socket), serial port, GPIB port and a socket for connection of a VGA colour monitor, to let you take advantage of a large colour screen. The latter is really good in teaching situations although the waveform resolution is not as good as from the scope itself, as you would expect.

The TDS 544A also has its own floppy disc drive which you can use for waveform capture or printouts. It is a standard 3.5-inch 1.44MB drive with IBM DOS formatting. It means you can store waveforms for subsequent display on the scope or you can take the data and incorporate it into reports. That is what has been done for the screen shots in this article. The screens have been captured as EPS (encapsulated PostScript®) files and then taken straight into PageMaker® for the page composition. However, there are a wealth of other print formats that can be used including HPGL, TIFF, BMP, PCX and so on. You can also use a range of inkjet, laser, thermal and

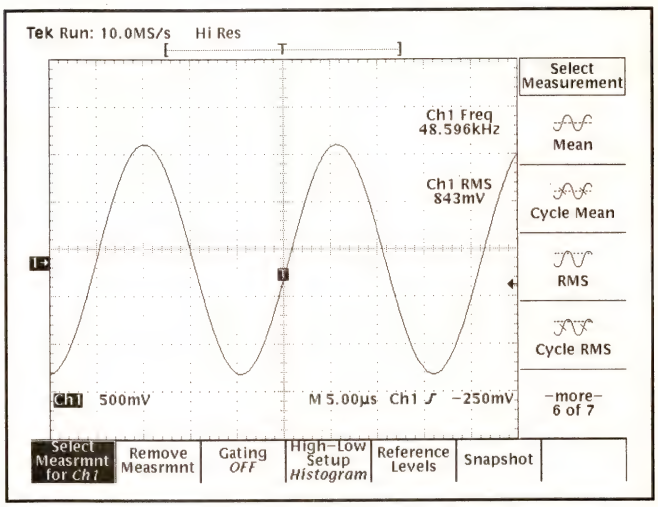


Fig.3: a 48kHz sinewave displayed in Hi Res mode whereby the sampling rate is greatly increased to improve display resolution. Note the measurement menu at the right of the screen.

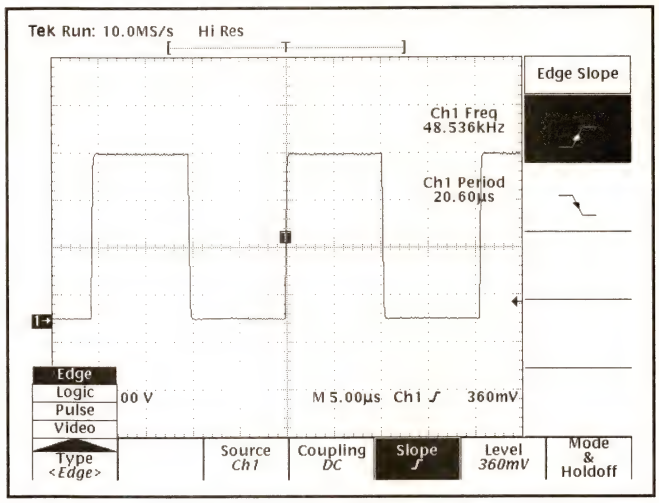


Fig.4: this is the TDS 554A's 1kHz calibration waveform depicted in Hi Res mode & showing one of the triggering menus. Note that triggering can be edge, logic, pulse or video.

dot matrix printers. Tektronix can even provide for colour printouts with one of their colour printers.

Reviewing a complex product such as this really does place us in a quandary. No matter how long the review is, there are many features which will either be glossed over or omitted altogether. So what we are presenting is really just a brief review. We have not said anything about the FFT feature, programming and the very extensive programming manual. A typical demonstration by one of Tektronix' sales engineers will take several hours and again, the demo will not show every feature.

However, no matter how you look at it, the TDS 544A is a very impressive product which is at the leading edge of technology. None of this comes cheap of course and nor would you expect it to. Prices range up from around $15,000, depending on the options fitted and supplied. The warranty is three years.

For further information on the TDS 544A, contact Tektronix Australia Pty Ltd on (008) 023 342. **SC**

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Cat K-5550

$449

Silicon Chip Sept/Oct/Nov '93

Siren Generator Kit

NEW

A simple kit that provides three loud siren sounds! Just a flick of a switch will sound either police, ambulance or fire engine sirens. With just a slight alteration, you can also get it to emit the sound of a machine gun firing. Operates on just 1 "AA" battery. Comes with all components,PCB, battery holder and speaker.

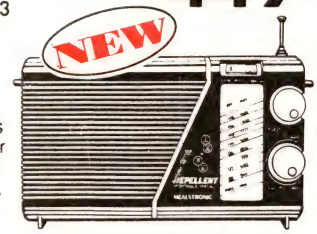
Cat K-5514

$9.95

Silicon Chip Nov '93

Build Your Own AM/FM Radio!

NEW



If you're intrigued by the way a radio works, this is the ideal kit to learn from. With the help of our comprehensive instructions, all you have to do is solder the components onto the circuit board, assemble all the hardware bits and you'll end up with a professional looking and sounding AM/FM radio. Your friends won't believe you built it yourself - the portable radio is very impressive with a large speaker for great sound. Plus, it runs on three 'C' sized batteries for long-life and is water resistant. It's a simple alignment process due to the single IC circuit, though some experience with soldering is necessary. The kit comes complete with all components, hardware, plastic casing with rubber seals, carry strap and telescopic antenna. (Batteries not included.)

Cat K-1042

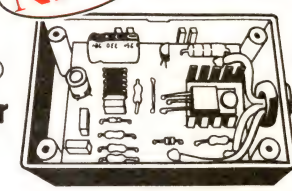
$49.95

EA Oct '93

Sick Of Getting A Flat Battery?

Car Light Switch-Off Timer

NEW

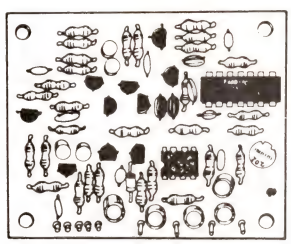


There's nothing worse than returning to your car to discover that the battery is flat. This scenario often caused by leaving your car's internal light on, either by not shutting the door properly or by simply forgetting to turn it off. That dreaded feeling will be a thing of the past once you build this kit! By connecting it with the positive supply to the interior light circuit, the light switch-off timer can control the power to the lamps and automatically turn them off after approximately two minutes. The kit comes complete with plastic case, hardware and all components.

Cat K-4212

$16.95

Silicon Chip Oct '93



Tune In To Hidden Signals!

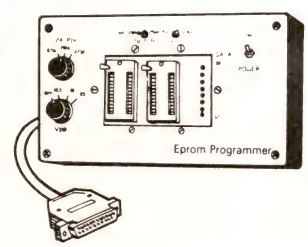
ACS Decoder

Now you can get more from your favourite FM radio stations! By taking advantage of the Ancillary Communications Service (ACS) that's employed by many FM broadcasters, you'll be able to listen in to special-purpose channels. These channels are only accessible by an ACS decoder. Everything is mounted on a single PC board that's compact enough to fit in most small receivers - it operates on a supply between 6V to 30V. Instructions show how to install the ACS decoder into our A-5235 Digitor AM/FM portable stereo. Kit will be supplied in short form with PCB and components only.

Cat K-5020

$18.95

EA Sept '93



Low-Cost Computer Programming

Eprom Programmer

Ever wanted to write instructions to control a microprocessor? With this sensational piece of equipment, you can program EPROMS the inexpensive way! The flexible and powerful programmer is controlled via the parallel port on an IBM compatible PC. It not only allows you to program EPROMs but it also has a readback feature. The hardware can handle EPROMS from 2716 (2K x 8) to 27256 (32K x 8) and it will also program 2816 and 2864 electrically erasable (EE) PROMS. Comes in full form with all components, hardware including 2 quality EPROM test sockets, case and pre-punched screened front panel.

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EA Oct '93

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Talking Screwdrivers?

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Compact Soldering Kit

A quality, yet very reasonably priced butane powered soldering tool. It comes in a compact kit complete with 4 tips, stand and cleaning sponge. Additionally, it includes a pair of cutters, a pair of pliers and a roll of resin-core soldering wire. (Gas not included).

Cat T-1200

$54.95

Storage Box

You won't misplace your tools! Keep all your tools together in this durable plastic storage box. Its small separate compartments allow you to keep different bits and pieces together while it also provides enough space to house your larger tools.

Cat H-2572

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Suited for switching headlights and spotlamps or as a safety cut-off switch in machinery via a relay, this is a low-cost single pole and single throw switch with screw terminals.

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NEW

LM627

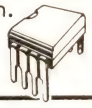
New To Dick Smith Electronics

Low Noise Operational Amplifier

Extremely fast and precise with minimal noise. Features a slew rate of 4.5 V/uS and a 14MHz gain bandwidth.

Cat Z-6023

$9.95



New Low Price

TDA 1514A IC Power Amplifier

50 Watt Hi-Fi power Amp SOT131 used as a building block in radio, TV and stereo amplifiers as well as other audio applications. Data available in all stores.

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Coming Soon!

OM 1681C

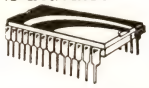
Car Security Alarm Hybrid I.C

NEW

A complete car alarm in one chip, requiring only minimal external components. It performs as a glass breakage amplifier & detector with protection against false triggering and RF interference. You can adjust both exit and entry delays and four pins are provided for a continuous alarm output, flashing alarm output, alarm status indicator and a low power output which is activated when the alarm is armed.

Cat Z-6190

$24.95



New Low Price!

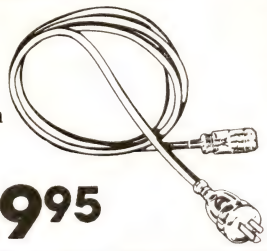
Surge/Spike Safety Lead

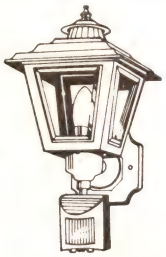
Protects Appliances From Damaging Surges!

Plug this lead into your computer or any other electrical appliance for protection against surges and spikes caused by unpredictable hazards such as lightning. It not only guards valuable electronic goods against permanent damage, it also automatically re-sets after absorbing a surge, unlike most which need to be replaced after the shock of one. Additionally, the safety lead features a green safety neon to indicate when the power is on and can protect any number of appliances on a power board or power point.

Cat M-7159

Was $39.95 **$29.95**





Wall-Mounted Security light

Ideal as a security light, this robust coach-light features a daylight sensor so it doesn't waste electricity by operating during the day, both manual and automatic operation and adjustable sensitivity control. Plus, you can adjust the time control from approx. 8 seconds to 2.5 minutes as well as the range and direction up to approximately 15 metres.

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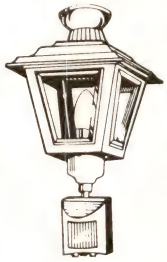

Eave-Mounted Security Light

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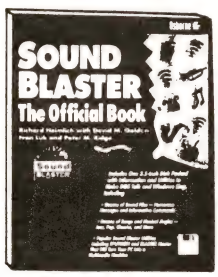

The one and only book written by sound Blaster manufacturers' Creative Labs, it covers the whole family of sound blaster cards including Sound Blaster Pro, the new Sound Blaster 16 and the Soundblaster Multimedia Kit. Comes complete with a 3.5" disk packed with information and utilities.

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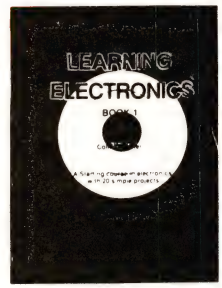

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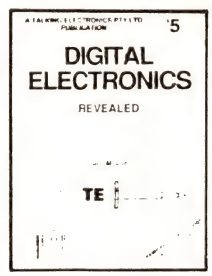

In a clear hand-written grid-page format this book provides all the information you need to understand digital electronics equipment. Distributed exclusively through Dick Smith Electronics stores, it's a concise and easy to read publication.

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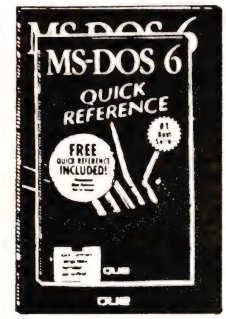
Using MS DOS 6.0 - Special Edition



A complete tutorial and manual coverir the new DOS versi 6.0.It incorporates a complete DOS Command Referenc guide and comes wi a bonus copy of the popular QUE DOS (Quick Reference Pocket Guide book valued at $19.95.

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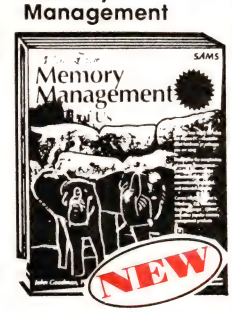
Memory Management



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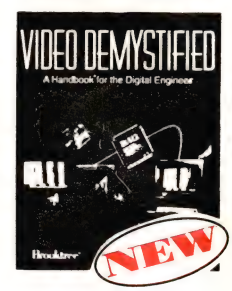

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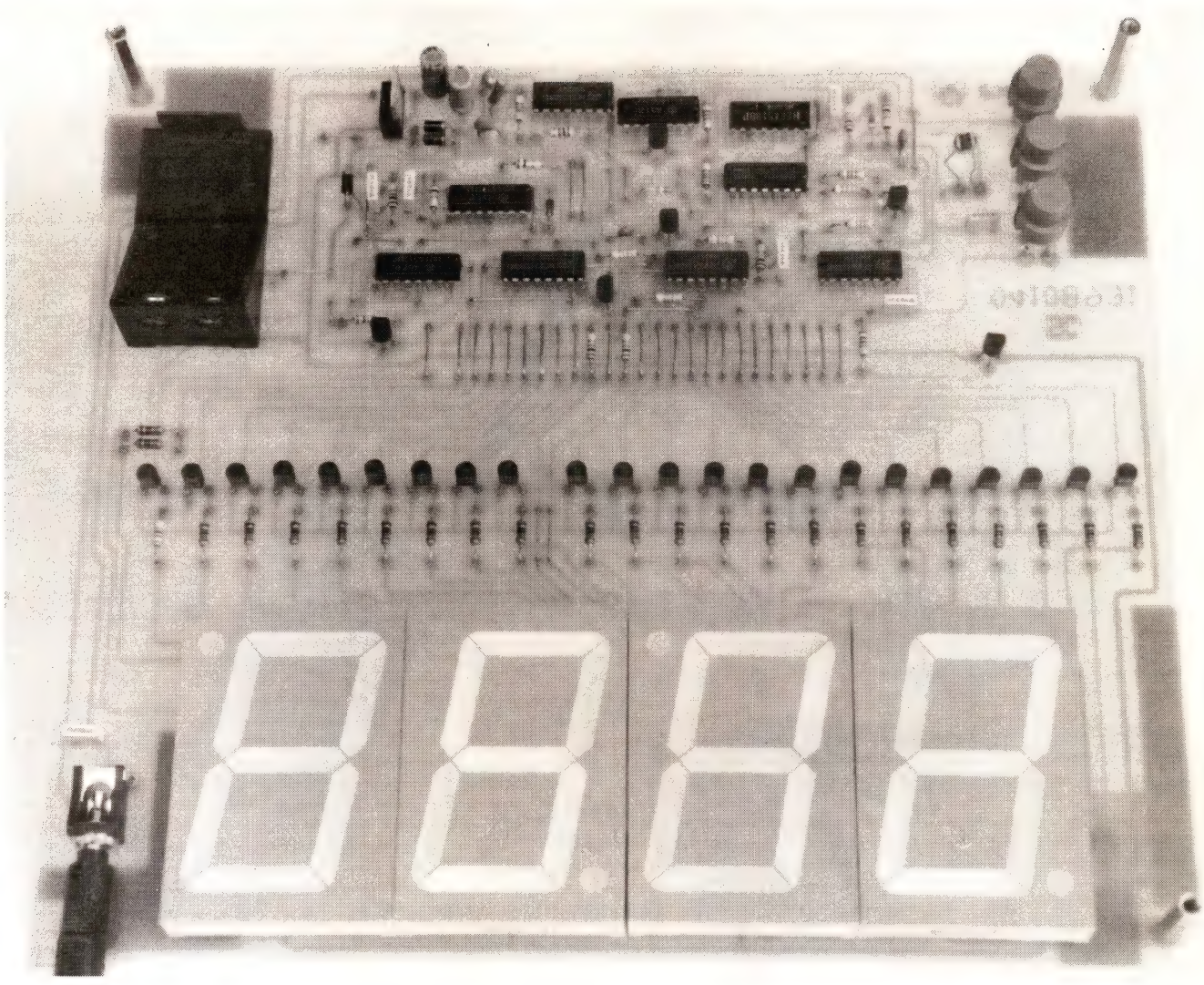


Build this Jumbo Digital Clock

Do you need a clock with a very large digital display? This Jumbo Clock uses 7-segment LED displays that are 70mm high. It has battery backup, automatic display dimming at night, AM/PM indication & a 12-hour display.

By DARREN YATES

OK, I admit it. Digital clocks are now so common that you can go down to your local supermarket and pick one up for around $15. So what? Have you ever tried to repair one of those clocks? Do you how they work?

Taking the back off won't give you any clues on either front. You're just confronted with a single chip (or more often these days, a single blob) and little else. Embedded inside this blob is a single large scale integration (LSI) chip which contains virtually the en-

clock circuit. You'll learn more by ng at a blank wall than looking at blob!

owever, when you build your own k, you get a circuit diagram that ws you how it works and, should thing go wrong, you can fix it your- without too many problems. And sticking to discrete ICs, you can the replacement parts just about rywhere.

More importantly, you learn how clock works. In particular, you rn about counters and crystal os- lators, and about LED displays and w to drive them. It may cost you re to start off with but it's always ney well spent. The odds are that you have a well-stocked junkbox, en you'll have many of the parts ready.

The Jumbo Clock featured here has e added attraction of having very rge display digits. It is designed to ng on a wall and can be easily read distances of 40 metres or more. It's st the shot for a factory or small siness, or any application that re- uires a large viewing distance.

lock diagram

The main sections of the clock are hown in the block diagram of Fig.1. uses an accurate frequency refer- nce which is divided down and used o clock a number of BCD counters nd a latch. There are three BCD ounters in all – two to count the inutes and one to count the hours rom 0-9. All three counters drive 7- egment LED displays via NPN tran- istor buffers.

The latch provides the 10-hour ount and drives two segments of a fourth LED display.

Let's go through the block diagram step-by-step and explain how it all works.

Basically, you can think of a clock as a specialised counter that increments once every minute. Unlike a conventional counter, it is presettable and has a somewhat unusual count sequence; eg, it counts from 59 to 00 and from 12 to 1.

Let's begin with the section that generates the pulses. These have to be accurate and that means that we can't use a simple RC-type oscillator to do the job. This type of oscillator drifts with temperature and any frequency variations can translate into quite large errors.

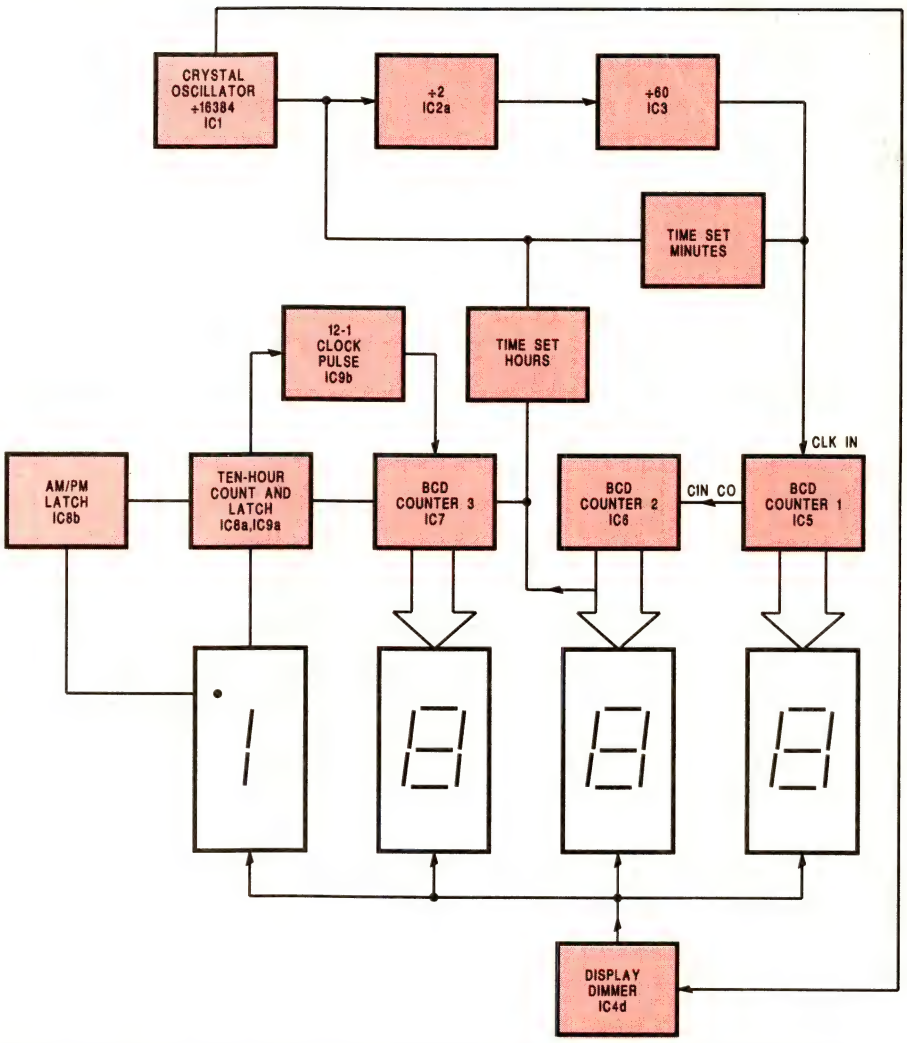


Fig.1: the Jumbo Clock uses a crystal-controlled oscillator (IC1) to generate an accurate reference frequency. This frequency is then divided down & used to clock BCD counters IC5-IC7 & a latching circuit (IC8a & IC9a). These in turn drive four 7-segment LED displays, while IC8b drives the AM/PM indicator.

What's needed is a very accurate frequency reference and this has been obtained by using a digital watch crystal. This type of crystal oscillates at 32.768kHz and this is divided down by 16,384 to obtain an accurate 2Hz square-wave signal.

To obtain one pulse every minute, we need a frequency of 0.0166Hz and so our 2Hz signal must be further divided by 120. This is achieved by first passing it through a divide-by-2 stage and then through a divide-by-60 stage.

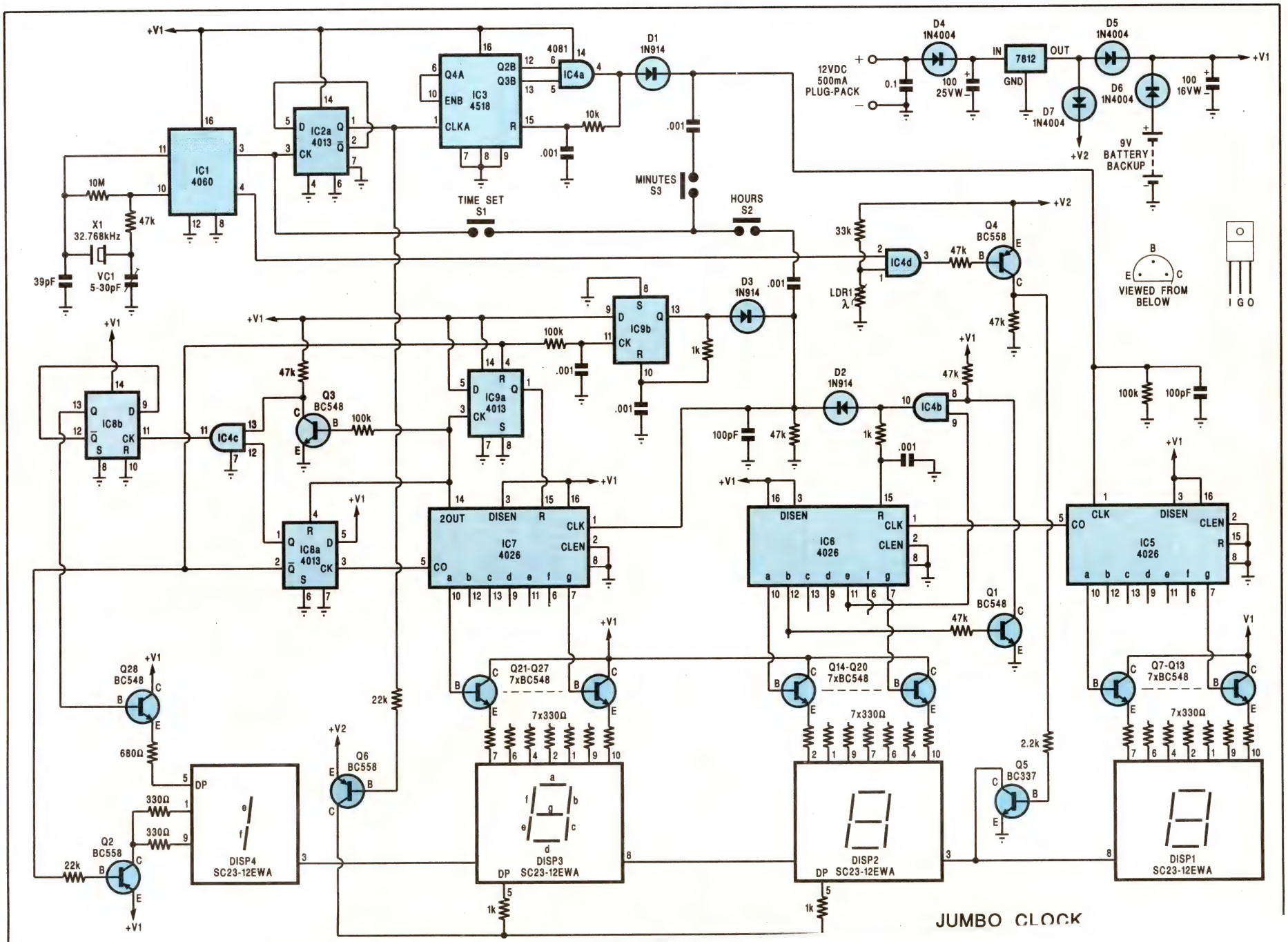
The resulting 0.016Hz signal is fed into counter 1, which is the 0-9 minutes counter. Its carry out (CO) output goes high on the 10th count and clocks counter 2 which counts the tens of minutes.

Because the maximum count that the minutes counter can display is 59, we have to detect the 60th count and this is done by checking counter 2's display driver outputs. When the 60th count is reached, the first two counters are reset and counter 3 is incremented by one.

Finally, the CO output from coun-

Main Features

- Jumbo-sized 4-digit LED read-out.
- 12-hour operation.
- Separate hours & minutes set-tings.
- Automatic display dimming at night.
- AM/PM indication.
- Crystal-controlled timing.
- 12VDC plugpack power supply with back-up battery.


+V1
+V2
12VDC 500mA PLUG-PACK
D4 1N4004
D5 1N4004
D6 1N4004
D7 1N4004
7812
IN
OUT
GND
100 25VW
100 16VW
0.1
9V BATTERY BACKUP
IC1 4060
IC2a 4013
IC3 4518
IC4a
D1 1N914
10M
47k
X1 32.768kHz
39pF
VC1 5-30pF
10k
.001
MINUTES S3
TIME SET S1
HOURS S2
33k
IC4d
Q4 BC558
LDR1
VIEWED FROM BELOW
E B C
I G O
IC9b
IC9a 4013
D3 1N914
100k
1k
IC8b
IC4c
Q3 BC548
IC8a 4013
IC7 4026
2OUT
DISEN
CLK
CLEN
IC6 4026
D2 1N914
IC4b
100pF
IC5 4026
CO
Q1 BC548
Q28 BC548
680Ω
330Ω
Q2 BC558
22k
DISP4 SC23-12EWA
Q6 BC558
Q21-Q27 7xBC548
Q14-Q20 7xBC548
Q7-Q13 7xBC548
7x330Ω
DISP3 DP SC23-12EWA
DISP2 DP SC23-12EWA
DISP1 SC23-12EWA
Q5 BC337
2.2k
JUMBO CLOCK

2 (left): all the IC numbers on the uit diagram are directly related to circuit diagram. IC5 is the 0-9 utes counter, IC6, the minutes tens nter, IC7 the 0-9 hours counter, & a & IC9a the 10-hour count & latch uit. These drive the LED displays transistors Q2 & Q7-Q27.

3 clocks a latch when a count of 10 urs is reached. This latch not only ves the two segments of the fourth D display but also drives a display ch to give AM/PM indication. It o provides a reset pulse to counter or the transition from "12" to "1" – ore on this later.

Time setting is achieved by feeding e 2Hz clock signal directly into unters 1 and 3 so that the minutes d hours can be incremented separately. This makes time-setting a eeze.

ircuit diagram

Fig.2 shows the full circuit details f the Digital Clock. Note that all the numbers on the block diagram can e related directly to the circuit diaram. IC5 is the 0-9 minutes counter, C6 the minutes tens counter, IC7 the -9 hours counter, and IC8a & IC9a the 0-hour count and latch circuit.

In greater detail, IC1 is a CMOS 4060 14-bit counter and oscillator which has its frequency set by a 32.768kHz watch crystal. A 39pF capacitor provides the correct loading for the crystal to ensure that it operates correctly, while a 5-30pF trimmer capacitor (VC1) allows the crystal frequency to be trimmed slightly so that the clock keeps accurate time.

The output from pin 3 of IC1 is the required 2Hz square-wave signal (ie, the crystal frequency is divided by 2^{14}). This signal is divided by flipflop IC9a to produce a 1Hz signal on pin 1 which, among other things, is used to flash the two centre decimal points on the display to divide the hours and minutes digits.

The 1Hz signal from IC2a is also fed to a divide-by-60 circuit based on IC3, a 4518 dual BCD counter. Both counters inside this IC are connected in cascade, with AND gate IC4a used to detect a '6' output from the second counter.

Pin 4 of IC4a drives an RC time constant consisting of a 10kΩ resistor and a .001μF capacitor. Each time IC3 reaches a count of 60, pin 4 of IC4a goes high, the capacitor charges and pin 15 of IC3 is pulled high. Thus, IC3 is reset to 00 a short time after the count of 60 is reached.

As a result, each time IC3 counts to 60, pin 4 of IC4a briefly switches high. IC4a thus delivers a 0.016Hz pulse train (ie, one pulse per minute) and this signal clocks minutes BCD counter IC5 via D1. Depending on the count, IC5's a-g segment outputs then drive LED display DISP1 via buffer transistors Q7-Q13 and their associated 330Ω current limiting resistors.

Similarly, counters IC6 and IC7 drive DISP2 and DISP3 via transistors Q14-Q27.

IC5's CO output clocks IC6 (the minutes tens counter) on every 10th count, as described previously. It's here that we strike the first wrinkle. When IC6 reaches a count of six, two things must happen: (1) IC5 & IC6 must both be reset to zero; and (2) a clock signal must be applied to hours counter IC7.

As it turns out, we can easily detect the 6th count by monitoring the "b" and "e" outputs from IC6. When a '6' is to be displayed, the "b" output segment is low and the "e" segment output is high. These two conditions only occur together at the 6th count.

Thus, on the 6th count, transistor Q1 will be off and pin 8 of IC4b will be high. Pin 9 of IC4b also goes high on the 6th count and thus pin 10 switches high and clocks hours counter IC7 via D2. IC4b then resets IC6 a short time later via the RC delay circuit connected to its output.

Because the time constant of this RC circuit is very small, the observer doesn't see the '6' appear. The output pulse from IC4b is still long enough to clock hours counter IC7, however.

Hours counter

This is where things start to get a little tricky. That's because IC7 must cycle from 1 to 9 to 0 (as in 1am-10am or 1pm-10pm), then from 1 to 2 (as in 11am-12pm or 11pm-12am), then from 1-0 again and so on.

This sequence is impossible for a 4026 UP counter to do on its own but it can be done by adding a small amount of extra circuitry based mainly on IC9a. We'll look at this in some detail shortly.

IC8 is a 4013 dual D-type flipflop, with IC8a connected as a latch to drive the leading display. Because this display either shows a '1' or is off, segments "e" and "f" are tied together via 1kΩ resistors and driven by the Q-bar output of IC8a via transistor Q2. When Q-bar is low, Q2 turns on and the two segments light to show a "1". Conversely, when Q-bar is high, Q2 and the segments are off.

IC8a is clocked by the CO output of IC7. When IC7 reaches a count of 10, its CO output goes high and Q-bar of IC8a goes low, thus turning on Q2 and

RESISTOR COLOUR CODES

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	10MΩ	brown black blue brown	brown black black green brown
❑	3	100kΩ	brown black yellow brown	brown black black orange brown
❑	7	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	1	33kΩ	orange orange orange brown	orange orange black red brown
❑	2	22kΩ	red red orange brown	red red black red brown
❑	1	10kΩ	brown black orange brown	brown black black red brown
❑	1	2.2kΩ	red red red brown	red red black brown brown
❑	4	1kΩ	brown black red brown	brown black black brown brown
❑	1	680Ω	blue grey brown brown	blue grey black black brown
❑	23	330Ω	orange orange brown brown	orange orange black black brown

PARTS LIST

1 PC board, code 04108931, 245 x 215mm
1 red Perspex panel, 250 x 220mm
1 3.5mm DC socket
1 12VDC 500mA plug pack
1 PC mount 9V battery holder
1 light dependant resistor (LDR1, Jaycar Cat. RD-3480)
3 pushbutton momentary switches (S1,S2,S3)
4 25mm tapped spacers
4 10mm x 3mm machine screws
1 32.768kHz watch crystal (X1)
1 9V battery
12 PC stakes

Semiconductors

1 4060 oscillator/14-bit counter (IC1)
3 4013 dual D flipflops (IC2,IC8,IC9)
1 4518 dual 4-bit BCD counter (IC3)
1 4081 quad 2-input AND gate (IC4)
3 4026 decade counter/display drivers (IC5-IC7)
24 BC548 NPN transistors (Q1,Q3,Q7-Q28)
3 BC558 PNP transistors (Q2,Q4,Q6)
1 BC337 NPN transistor (Q5)
1 7812 3-terminal regulator
4 SC23-12EWA common-cathode 7-segment 70mm LED displays (DISP 1-4)
3 1N914 signal diodes (D1-D3)
4 1N4004 silicon diodes (D4-D7)

Capacitors

2 100µF 25VW electrolytic
1 0.1µF 63VW MKT polyester
6 .001µF 63VW MKT polyester
2 100pF ceramic
1 39pF ceramic
1 5-30pF trimmer capacitor (VC1)

Resistors (0.25W, 1%)

1 10MΩ	1 10kΩ
3 100kΩ	1 2.2kΩ
7 47kΩ	4 1kΩ
1 33kΩ	1 680Ω
2 22kΩ	23 330Ω

Where to buy the parts

Kits for this project will be available exclusively from Jaycar Electronics Pty Ltd, who sponsored the design.

the "e" and "f" segments of the leading hours digit.

Now let's see how IC7 cycles through its count sequence. As already discussed, clock pulses are applied to IC7 at regular 1-hour intervals via diode D2. Assume for the moment that the time is currently 1:59; ie, IC7 is at a count of "1". When the next clock pulse arrives, IC7 goes to a count of 2 (ie, we have 2:00 on the displays) and this causes the "2OUT" pin (pin 14) to go low.

This low transition is ignored by the clock input of IC9a, since this flipflop can only change state when its clock input goes from low to high (provided its Reset input is low). When the next clock pulse occurs, IC7 goes to a count of "3" and pin 14 of IC7 goes high again.

This high is applied to the clock input of IC9a but IC9a ignores the clock pulse on this occasion. That's because its reset input (pin 4) is held high by the Q-bar output from IC8a. However, when the count in IC8a and IC7 reaches 13, Q-bar of IC8a is low. IC9a thus switches its Q output (pin 1) high on receipt of the clock pulse and this resets both IC7 and IC8a.

Q-bar of IC8a now goes high ag and turns off transistor Q2 and leading digit (ie, the leading digi blanked). At the same time, IC7 reset to "0".

But we don't want the hours ur display to show "0"; we want it show a "1" instead. That's achiev by using the Q-bar output of IC8a clock IC9b when it switches high turn off the leading hours digit. Wh that happens, IC9b's Q output switcl high and feeds a clock pulse to IC7 v D3 to that IC7 immediately advanc to a count of 1.

IC9b then resets itself almost imm diately via the RC time constant on pin 13 output.

In summary then, the hours cour ers (IC7 & IC8a) count to 12 and a reset to 0 on the 13th count. IC7 then immediately clocked to produc a "1" on the display. This all happer very quickly so that, as far as the ol server is concerned, the display goe straight from "12:59" to "1:00".

Q3, IC4c and IC8b are used to driv the AM/PM indicator. Q3 inverts th 2OUT output from IC7 and drives on input of AND gate IC4c, while the (output of IC8a drives the other inpu

This view shows the completed Jumbo Clock with the Perspex cover in place. The time-setting switches & the LDR (which controls the display dimming) are at top right.

FM TRANSMITTER MK1 KIT

This unit has most of the features of our previously advertised FMTXMK2 transmitter, but is much, much smaller. The complete transmitter PCB Miniature microphone included) is the size of a "AA" battery, and it is powered by a single "AA" battery. We use a two "AA" battery holder (provided) for the case, and a battery clip (Switch) for the switch. Estimated battery life is over 500 hours!! SAME PRICE AS OUR FMTXMK2:

$11 ea or 3 for $30

LASER POINTER

When this magazine goes to print we will have in stock a very small 5mW-670nM laser diode based pointer. This pointer actually uses a 5mW laser diode: Very bright! Do not be misled by advertisements that advertise pointers with a power output of 5mW maximum, as these could have a power output of as little as 1mW. The SPECIAL introductory price for our pointer is an all time low:

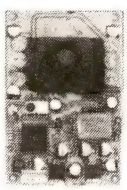
$139

APC VISIBLE LASER DIODE KIT

Our best visible laser diode kit ever! This one is supplied with a 5mW-670nM diode and the lens already mounted in a small brass assembly, which has the three connecting wires attached. The lens used is the most efficient we have seen, and its focus can be adjusted. We also provide a PCB and all onboard components kit for a driver kit that features Automatic Power Control (APC). Head has a diameter of 11mm and is 22mm long, APC driver PCB is 20 x 23mm, 4.5-12V operation at approx 80mA.

$85

MINIATURE CCD CAMERA



A monochrome CCD Camera that is totally assembled on a small PCB and includes an Auto Iris lens: Overall dimensions of camera are 24 X 54 X 120mm. The camera can work with as little as 0.1 lux illumination, and it is IR responsive! The six IR leds that are included on the PC.B. are useful for producing good images in a totally dark room! Available in EIA or CCIR standards.

$199

VOICE RECORDING MODULES

These "State of the art" solid state voice recording modules can record and play back messages up to 20 seconds long. They are very small and produce good quality sound. Include PCB assembly, microphone, speaker and a battery holder. INCREDIBLE PRODUCT AT ONLY:

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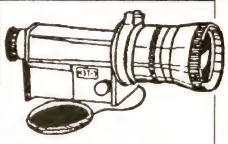
PASSIVE NIGHT VIEWER



This is a completed commercial monocular hand held night viewer, that employs an image intensifier tube: Luminous gain of 12500! The viewer is of a USSR military standard, and will produce useful images in as little as starlight illumination. Has adjustable low light objective lens, adjustable eyepiece, and is supplied with a carry case. Limited supplies at an incredible price of:

$799

PRECISION STEPPER MOTOR

This precision 4 wire Japanese stepper motor has 1.8 degree steps: That is 200 steps per revolution! 56mm diameter, 40mm high, drive shaft has a diameter of 6mm and is 20mm long. 7.2V-0.6A DC. We have a good. but LIMITED supply of these brand new motors:

$20

9" AMBER MONITOR

These are non enclosed composite monitors that can be powered from a 12V D.C. supply.

$60

IR LASER DIODE SPECIAL

If you have never experimented with laser diodes, don't miss out on this SPECIAL. We supply a brand new 780nM LASER DIODE (Barely visible) with small plastic COLLIMATING LENS to suit, a HEATSINK for the diode, a PCB and components kit for a suitable CONTANT CURRENT DRIVER, a suitable PIN DIODE that can serve as a detector, plus some INSTRUCTIONS. Suitable for medical use, perimeter protection, data transmission, IR illumination, etc. Experimenters delight at a SPECIAL PRICE OF ONLY:

$30

UNINTERRUPTABLE POWER SUPPLY (UPS)

THESE ARE VERY COMPACT, HIGH QUALITY, UPS's. They feature a 300W-450W **SINE WAVE INVERTER.** The inverter is powered by two series 12V-65AHr. (24V). batteries that are built into the unit. **There is only one catch:** Because these NEW units have been in storage for a while, we cannot guarantee the two batteries for any period of time, but we will guarantee that the batteries will perform in the UPS's when these are supplied. We will provide a three month warranty on the UPS's, but not on the batteries. A circuit will also be provided. **PRICED AT FRACTION OF THEIR REAL VALUE: BE QUICK!**

$299

We may also have some similar 600 Watt UPS's available: Similar story. New 6.5 AHr. batteries: $35 ea. Freight charge: $15 per UPS.

BACKLIGHTING INVERTER KIT

This kit inverter can power all the Fluorescent screens that are supplied as an option with many LCD displays. 5-12V operation with adjustable output power for different screen powers — brightness. A 60 X 45mm fluorescent screen and a plastic case will be supplied for FREE with each kit. When powered by the inverter this screen will light a brilliant white whilst the inverter only draws 100mA from the battery: Very efficient small fluorescent light! Experimenters delight at only:

$12

For the inverter kit and one screen. Additional screens $3 ea.

PLASMA BALL KIT

This kit will produce a fascinating colourful changing high voltage discharge in a standard domestic light bulb. The EHT circuit is powered from a 12V supply and draws a low 0.7A. We provide a solder masked and screened PCB, all the onboard components (Flyback transformer included), and the instructions at a SPECIAL introductory price of:

$29

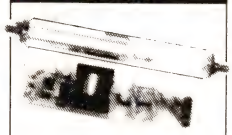
We do not supply the standard light bulb or any casing. The prototype supply was housed in a large Coffee jar, with the lamp mounted on the lid: A very attractive low cost housing!! Diagrams included.

IR VIEWER "TANK SET"

ON SPECIAL is a set of components that can be used to make a complete first generation Infra Red night viewer. These matching lenses tubes and eyepieces were removed from working tank viewers, and we also supply a suitable EHT power supply for the particular tube supplied. This power supply may be ready made or in kit form: Basic instructions provided. The resultant viewer requires IR illumination.

$150-$200

12V OPERATED LASER



This combination includes one used 3mW SIEMENS visible red laser tube and one 12V Universal Laser power supply MKIII kit. The inverter is easy to construct since it is supplied with a prewound transformer, and solder masked and screened PCB.

$89

INDUCTIVE PROXIMITY SWITCHES

These industrial quality detectors will detect ferrous and non-ferrous metals at close proximity. Some are DC powered (10-30V), some are mains AC powered, and all will switch loads directly. All have three wires for connecting into circuitry: Two for the supply, and one for switching the load. These also make excellent sensors for rotating shafts etc. LIMITED SUPPLIES. ON SPECIAL AT:

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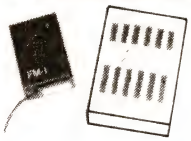
MINIATURE FM TRANSMITTER



Not a kit, but a very small ready made self contained FM transmitter enclosed in a small black metal case. It is powered by a single small 1.5V silver oxide battery, and has an inbuilt electret microphone. SPECIFICATIONS: Tuning range: 88-108MHz, Antenna: Wire antenna-attached, Microphone: Electret condenser, Battery: One 1.5V silver oxide LR44/G13, Battery life: 60 hours, Weight: 15g, Dimensions: 1.3" X 0.9" X 0.4". Some would call this a miniature "BUG" and sell it for much more than our price:

$32

LIGHT MOTION DETECTORS

Small PC.B. Assembly based on a ULN2232 IC. This device has a built in light detector, filters, timer, narrow angle lens, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness: With IR LED. Full information provided. The IC only, is worth $16! OUR PRICE FOR THE ASSEMBLY IS:

$7 ea. or 5 for $30

HIGH INTENSITY LED's

Narrow angle 5mm red LED's in a clear housing. Have a luminous power output of 550-1000mCD @ 20mA: That's about 1000 times brighter than normal red LED's. **SPECIAL UNBELIEVABLE INTRODUCTORY PRICE:**

60c ea. or 10 for $5

ATTENTION ALL MOTOROLA MICRO-PROCESSOR PROGRAMMERS

We have advanced information about two new STATE OF THE ART microprocessors to be released by Motorola: 68C705K1 and 68HC705J1. The chips are fully functional micros containing EPROM/OTPROM and RAM. Some of the features of these new LOW COST chips include:

- **16 pin DIL for the 68HC705K1 chip**
- **20 pin DIL for the 68HC705J1 chip**
- **10 fully programmable bi-directional I/O lines**
- **EPROM and RAM on chip**
- **Fully static operation with over 4MHz operating speed.**

These two chips should become very popular. We have put together a SPECIAL PACKAGE that includes a number of components that enable "playing" with the abovementioned new chips, and also some of the older chips.

IN THIS PACKAGE YOU WILL GET:

- **One very large (330 X 220mm) PCB for the Computer/Trainer published in EA Sept. 93, one 16X2 LCD character display to suit, and one adaptor PCB to suit the 68HC705C8.**
- **One small adaptor PCB that mates the programmer in EA Mar. 93 to the "J" chip, plus circuit.**
- **One stand alone programmer PCB for programming the "K" chip plus the circuit and a special transformer to suit.**

THE TOTAL COST OF THE ABOVE PACKAGE IS ON SPECIAL AT A RIDICULOUS PRICE OF:

$99

Note that the four PCB's supplied are all silk screened and solder masked, and have plated through holes. Their value alone would be in excess of $200!! A demonstration disc for the COMPUTER/TRAINER is available for $10. No additional software is currently available. Previous purchasers of the COMPUTER/TRAINER PCB can get a special credit towards the purchase of the rest of the above package.

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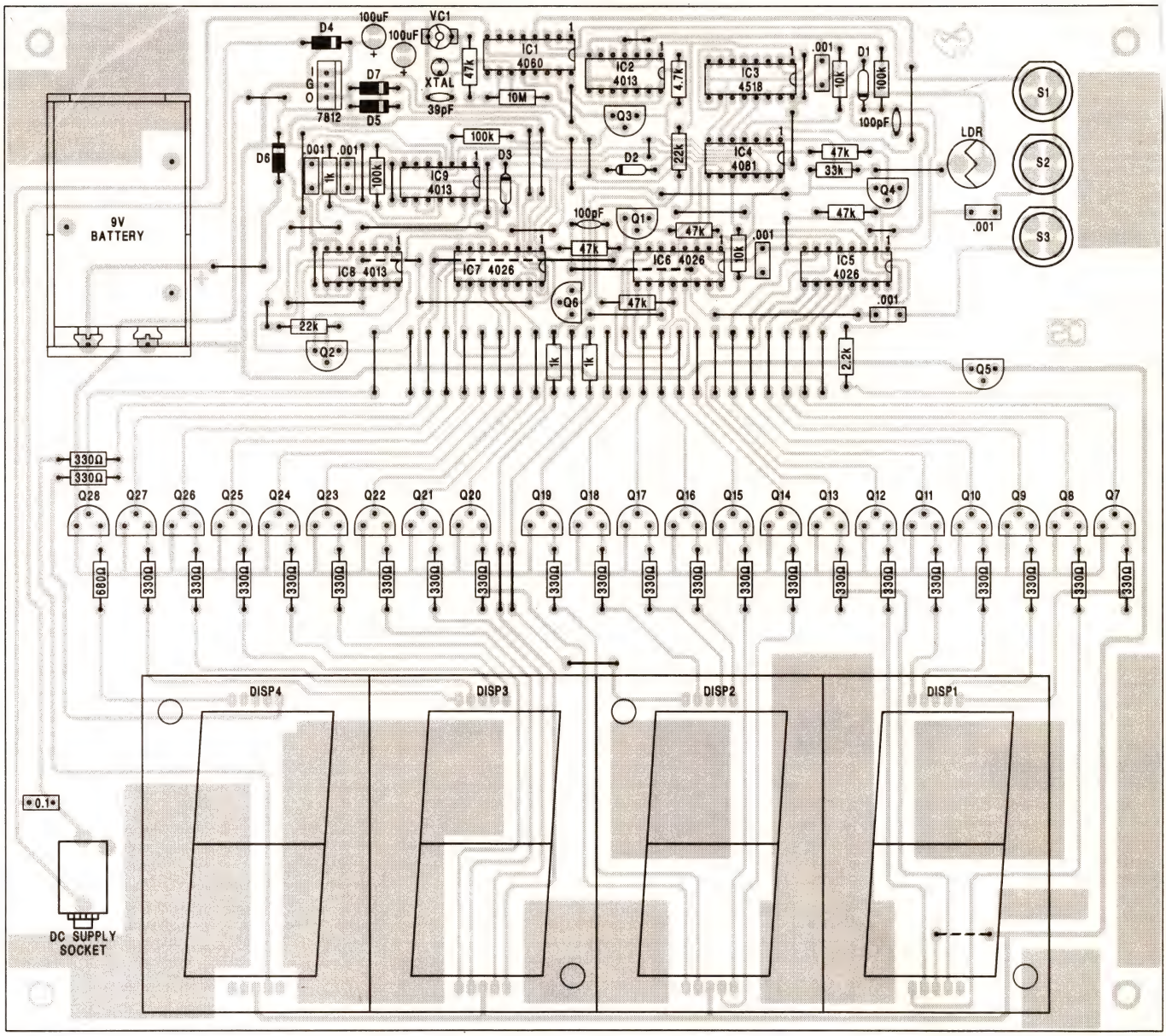


Fig.3: all the parts for the Jumbo Clock are mounted on one large PC board. Take care when installing the LED displays, as DISP2 & DISP4 must be installed upside down (see text). Power for the circuit comes from a 12V DC plugpack supply, while a 9V battery powers the timekeeping circuitry during blackouts.

(pin 12) of the AND gate. Pin 11 of IC4c thus clocks IC8b every 12 hours to toggle the AM/PM indicator.

The AM/PM indicator itself is actually the decimal point on the leading digit. A very simple trick is used so that it appears in the top lefthand corner of the display – the display is installed on the PC board upside down!

Time setting

Pushbutton switches S1, S2 and S3 perform the time setting function. To set the time, S1 (TIME SET) is held down and then either S2 pressed to set the hours or S3 pressed to set the minutes. The circuit works like this: when S1 is pressed, 2Hz clock pulses from IC1 are coupled through to S2 and S3. If S2 is now pressed, these 2Hz pulses are differentiated by a .0015µF capacitor and fed to pin 1 of IC7 to increment the hours display. Similarly, if S3 is pressed, the minutes 0-9 counter is clocked.

Display dimming

IC4d, Q4, Q5 and an ORP12 light dependent resistor (LDR1) provide the automatic dimming function for the LED displays. The LDR and its series 33kΩ resistor form a variable voltage divider, the output of which depends on the ambient light level. This output is fed to one input of AND gate IC4d.

The other input of IC4d is driven by a 512Hz square-wave signal derived from pin 4 of IC1. If the ambient light level is high, the resistance of the LDR is low and the output from IC4d is also low. Conversely, if the light level is low, the LDR's resistance is high and IC4d gates through the 512Hz square-wave signal from IC1.

IC4d drives PNP transistor Q4 via a 47kΩ base current-limiting resistor. When IC4d's output remains low (ie, the light level is high), Q4 turns on and thus Q5 also turns on and the displays are driven at a 100% duty cycle to provide maximum brightness.

Conversely, when the light level is low, IC4d switches Q4 and thus Q5 on

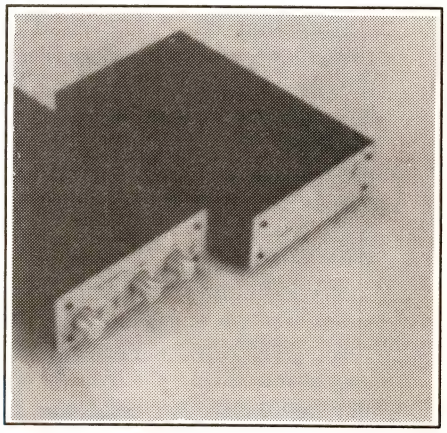
Music speaks louder than words"

SPECIFICATION

Input impedance	24Kohms
Input sensitivity for 1.3v o/p	115mV
Output impedance	760 ohms
Total Harmonic Distortion	0.1%
Frequency response	20 to 20,000Hz+/-0.1 dB
Power requirements	240 VAC +/-10%50Hz, 13W
Weight	2.4Kg Net, 3.3Kg Gross
Dimensions	8½" (213mm) x 14¾" (369mm) x 3¾" (85mm)

Output power	120Wrms/ch into 8-ohms
Frequency response	0.3Hz to 180kHz
Total Harmonic Distortion	0.2%
Input impedance	24K
Input sensitivity	1.3V
Power requirement	240 VAC+/-10%, 50Hz
Weight	5.7Kg Net, 6.5Kg Gross
Dimensions	8½"(213mm) x 14¾"(369) x 3¾"(85mm)

Specifications subject to changes with out prior notice, System manufactured in Thailand



Magnet VL-3/MA-3

The Magnet VL-3 is a hybrid vacuum tube stereo line-amplifier. It uses JFET at the input stage and uum tube at the output stage. This combination helps in long life and better music quality. By using JFET the maintenance cost by way of replacing the tube often is reduced.

The VL-3 has CD, TUNER, VIDEO, TAPE and AUX inputs. The output stage uses a cathode lower vacuum tube which makes a low output impedance. It has a three-part regulated power supply ich reduces the modulation distortion, AN automatic muting timer circuit allows time for the tube neat up during power-on and hence stops any output to the speaker till the tube is ready.

The circuit uses polypropylene capacitor, REL-cap, Wonder cap, Monster cable and 1% metal film istors. A fibre glass epoxy double sided PCB with ground plane is used to avoid stray chassis is made black anodised aluminium to reduce the magnetic field and to promote good heat dissipation.

The Magnet Ma-3 is a 120 Wrms/ch into 8-ohms stereo amplifier. The circuit is based on a fully mplimentary symmetrical push-pull design with direct coupling between stages. The MA-3 input and e-drive stages use JFET cascode with BJT to give a very wide frequency response up to 180KHz. The tput uses two pairs of transistors per channel to give a continuous high output. The MA-3 uses a roidal transformer to supply high power and also to reduce the interference. The PCB is double-sided ith plated-through holes to reduce the jumpers and wiring which in effect reduces the signal travel path. ne chassis is made up of anodised aluminium to reduce magnetic interference and for good heat ssipation. The MA-3 has a DC fault protection circuit to protect itself and the speaker from any ngerous faults. This circuit will not affect the sound quality in any way.

The MA-3 uses a 400VA toroidal transformer for its supply. It uses 1% metal film resistors, WIMA pacitors and Monster Cable. This unit gives a longlasting performance during continuous operation.

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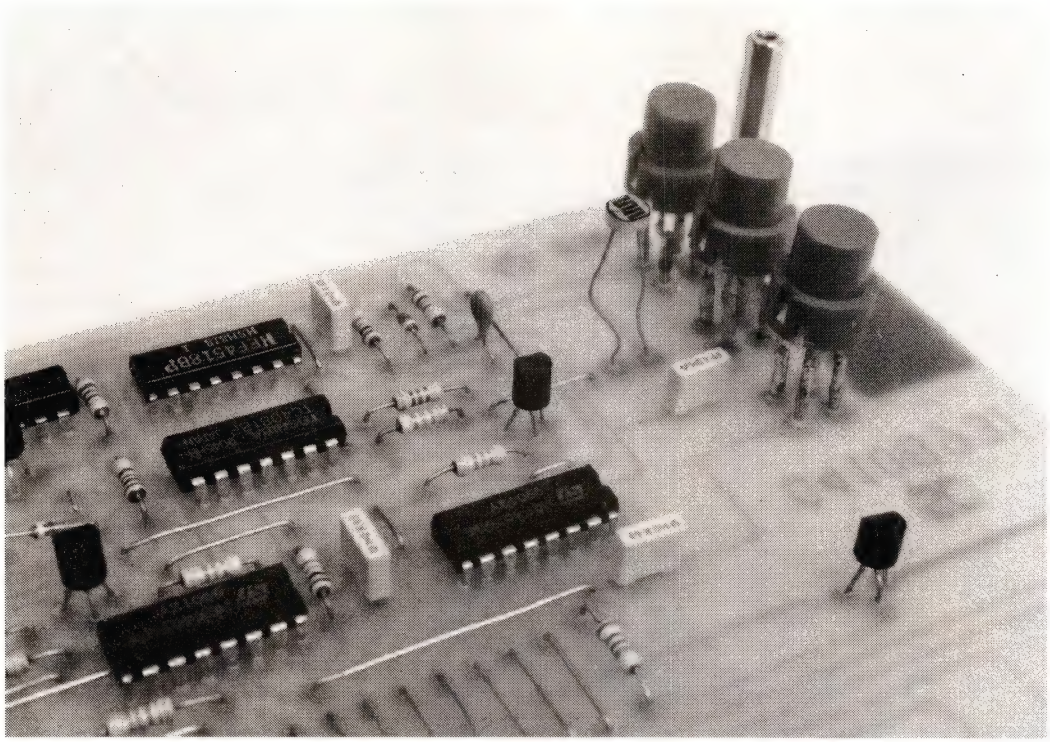

The three time-setting switches are mounted soldering their pins to stakes, as shown here. Make sure that the switches are correctly oriented (flat side to to of board) – see Fig.3. Tl LDR is mounted with it leads left at full length can be installed either way around.

and off at a frequency of 512Hz. Q5 in turn switches the displays on and off at this frequency to reduce the display brightness.

Note that the jumbo-sized 70mm LED displays used in this project have the same pinouts as the smaller types but each segment contains five LEDs in series. This makes it necessary to use transistors Q7-Q27 in order to obtain sufficient display brightness.

Power supply

Power for the circuit is derived from a 12V DC plugpack supply. The incoming DC is fed via reverse polarity protection diode D4 to a 3-terminal 12V regulator. Two separate supply rails are then derived from the output of the regulator via isolating diodes D5 and D7. The +V1 rail powers all the timekeeping circuitry and the driver transistors for the LED displays, while the +V2 rail powers the dimming circuit which in turn controls common digit-driver transistor Q5.

A 9V backup battery is used to supply the timekeeping circuitry if the mains fails. This battery is isolated from the +V1 rail via D6 which is normally reverse biased. When the mains fails however, D6 becomes forward biased and the battery takes over and supplies power to the +V1 rail.

During this time, diode D5 is reverse biased and so Q5 is off and the LED displays are blanked. This was done to conserve the batteries in the event of a long blackout. The LED displays come back on again and show the correct time as soon as the mains power is restored.

Construction

All the components for the digital clock are installed on a single PC board coded 04108931. Fig.3 shows the parts layout on the board.

Before installing any of the parts, check the board carefully for etching defects (eg, shorted or open-circuit tracks). There shouldn't be any problems here but it's always best to make sure.

When you're satisfied that everything is correct, you can start construction by installing PC stakes at all external wiring points and at the switch mounting positions. This done, install the wire links, resistors and capacitors. Make sure that the wire links are straight so that they don't short against other parts.

You can straighten the link wire if necessary by clamping one end in a vice and then stretching the wire slightly by pulling on the other end with a pair of pliers.

The semiconductors can now be installed on the PC board, followed by trimmer capacitor VC1 and the 32.768kHz watch crystal. Be sure to use the correct part at each locatio and check that all parts are correctl oriented.

In particular, check the transisto type numbers carefully and note tha all the ICs face in the same direction The 3-terminal regulator is installec with its metal tab towards the adja cent power diodes (see Fig.2 for the pin connection details).

LED Displays

Now for the four LED displays. These are installed directly on the board but there is a catch – displays 2 and 4 must be installed on the board upside down (ie, their decimal points must be at top left – see Fig.3).

The other two LED displays (1 & 3) are installed in the usual manner (ie, decimal points at bottom right). Push all the displays down onto the board as far as they will go before soldering their pins.

Once the displays are in, the board can be completed by installing the pushbutton switches, the battery holder and the LDR. The LDR can be installed either way around and should be soldered in with its leads at maximum length, so that it sits about 25mm above the board.

The three pushbutton switches are mounted directly on top of the previously installed PC stakes. Be sure to orient the flat side of each switch body

hown in Fig.3 and make sure that are vertical and don't lean to one e.

A red Perspex cover was fitted to prototype to enhance the appear-ce of the LED displays and to hide circuitry. This cover measures 250 20mm and is mounted on the board ing four tapped 25mm spacers and m screws. You will need to mark t and drill a mounting hole in each rner of the cover, plus clearance les for the time-setting switches and e LDR.

The clearance holes are best made first drilling small holes and then larging them to size using a tapered amer.

esting

Now for the smoke test. Connect ie DC plugpack supply and switch n – you should immediately get a eadout on the displays, although it night not make much sense at this tage. That's because the 4026 counters an switch on in a random mode and roduce incorrect symbols.

To correct the displays, all you have o do is press the time setting buttons ie, Time Set + Hours and Time set + Minutes) until the counters are clock-ed and revert to a valid condition.

If the clock doesn't work, switch off and check for wiring errors. In particular, check for incorrect parts placement on the PC board and for shorts between soldered joints on the back of the board. If the displays don't make much sense, check for shorts between the display segments and that the displays have been correctly oriented (displays 2 & 4 must be installed upside down).

If all is well so far, connect the 9V battery back-up battery, set the time and switch off the mains power. The display should now go out but the timekeeping circuitry should continue to function. Leave the mains power off for a few minutes, then switch it back on again. The display should now come back on and show the correct time. Check that diodes D5 and D6 are correctly oriented if you strike problems here.

Finally, check that the display dimming feature works by covering the viewing hole for the LDR. The accuracy of the clock can be adjusted by monitoring it over a 24-hour period and tweaking VC1 on a trial and error basis. **SC**

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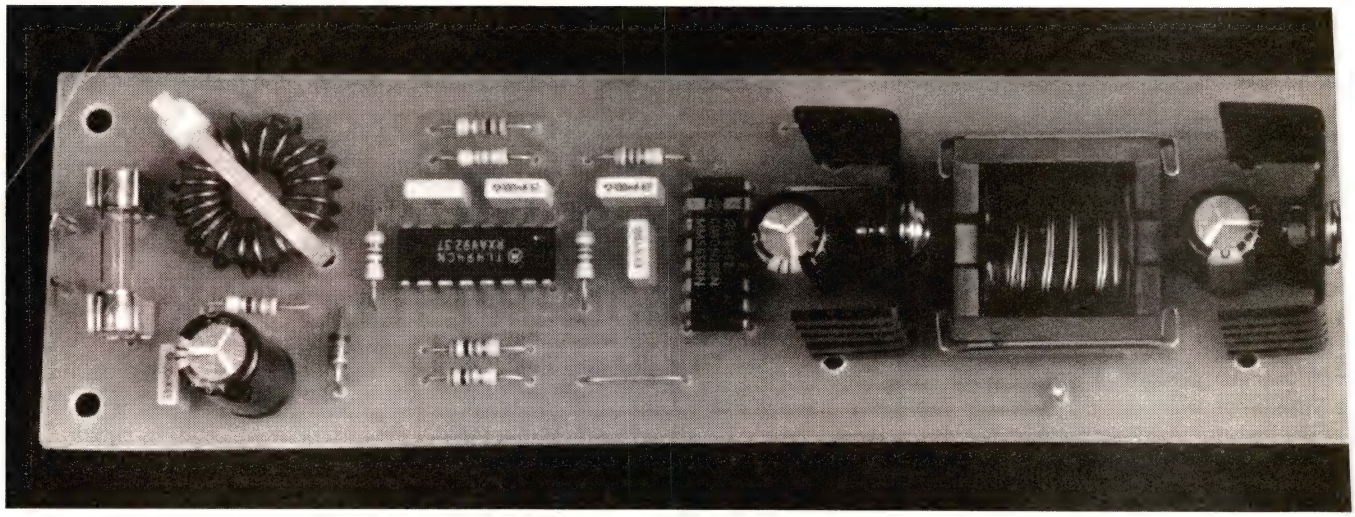


A high efficiency inverter for fluorescent tubes

This high efficiency inverter will power either an 18W or 36W slimline fluorescent tube from a 12V battery. It can be used for camping, emergency lighting or as part of a solar powered lighting installation for remote areas.

By JOHN CLARKE

Fluorescent lighting has many benefits over incandescent lamps. Fluorescent tubes use far less power than the equivalent light output incandescent lamps. They also provide a relatively diffuse light since the light is emitted from a large surface rather than from the virtual point source of a light bulb.

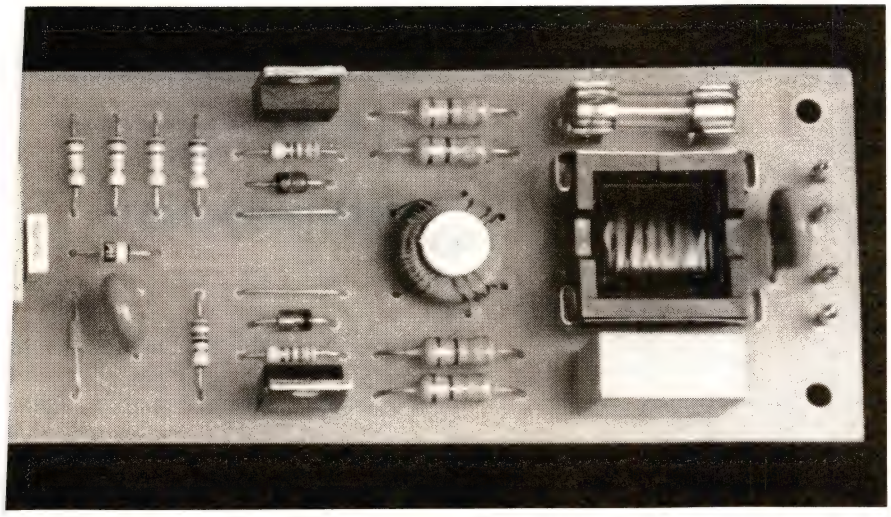
Battery powered fluorescent inverters are very common these days. You can find them in small portable lamps, in caravan, bus and boat lighting and in automotive inspection lamps. In most of these, a self-oscillating single transistor inverter steps up the voltage from the battery to a high AC voltage sufficient to start the tube. Once the tube is lit, the inverter transformer then provides current limiting for safe operation. This is a simple system that works but it does have a few problems.

Firstly, these simple inverters are not very efficient. This is because the inverter must provide a very high voltage (usually in excess of 1000V AC) in order to start the tube but only deliver 100V or less once the tube has fired. This means there are considerable losses in the inverter transformer and to a lesser extent in the transistor drive circuitry. Because of this, simple inverters are rarely practical for tubes of more than 20 watts output.

Another problem with simple inverters for fluorescent tubes is their lack of voltage regulation. This makes no allowance for the fact that the voltage across a battery falls as it becomes discharged. Consequently, the tube may be over-bright on a fully charged battery and become noticeably dimmer as the battery discharges.

A consequence of brute force starting and overdriving when running is shortened tube life. For maximum life, they must be started correctly and some form of regulation must be included to avoid overdriving the tube when the battery voltage is high.

Our new inverter design overcomes the above shortcomings and has high efficiency. It can be made to suit 18W and 20W tubes or 36W and 40W tubes. The tube filaments are preheated for correct starting and the circuit incorporates voltage regulation so that the tubes will have long life. Furthermore,



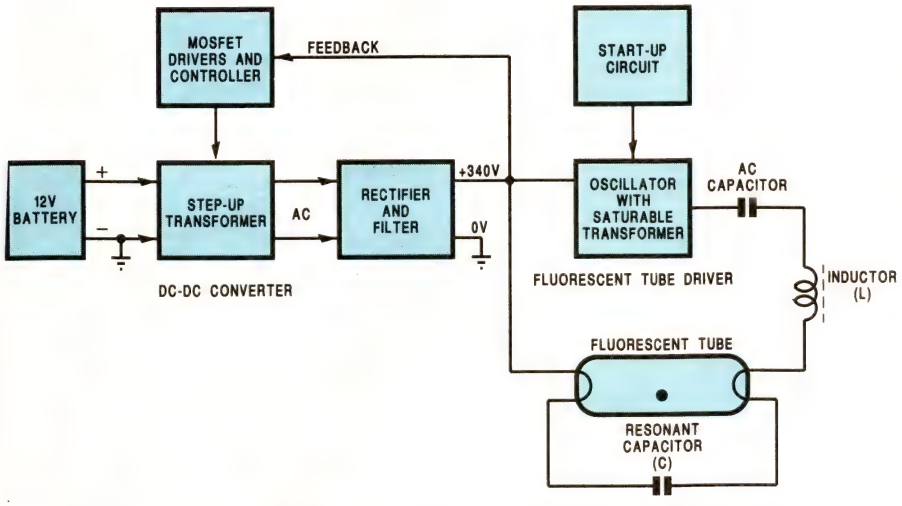


Fig.1: this block diagram shows the main circuit features of the fluorescent inverter. Note the feedback to maintain a constant DC voltage from the rectifier output. This ensures constant brightness with varying battery input voltage.

since the tubes are run at a very high frequency, there is no flicker, either at start-up or during running. Nor is there is any hum or audible whistle and radio interference is low.

The inverter is designed to be housed in a standard 18W or 36W batten fitting so that the fluorescent inverter and lamp are an integral unit.

Block diagram

Fig.1 shows the block diagram of the fluorescent inverter circuit. It comprises a DC-DC converter (which steps the 12V up to 340V DC) and a fluorescent tube driver circuit.

The DC-DC converter employs a step-up transformer which is driven by two Mosfet transistors at a frequency of around 120kHz, as set by a switchmode controller IC. The resulting high voltage AC output from the transformer is rectified and filtered to provide DC. Feedback is applied from the output to the switchmode controller IC to maintain the DC voltage at 340V.

Main Features

- Suitable for 18W and 20W or 36W and 40W tubes
- High efficiency
- Fast starting without flicker
- Filaments preheated
- Constant lamp brightness from 11-14.4V supply
- Light output equal to conventional mains-powered lamp
- Reverse polarity fuse protection
- Fuse protection for faulty tube
- Low electromagnetic radiation

The 340VDC is applied to the fluorescent tube driver circuit. This is essentially a free-running oscillator once the tube is running but a start-up circuit is required to allow the tube to fire. The start-up circuit applies a pulse train to the oscillator and if a tube is connected, the oscillator runs at a frequency set by the series inductor (L) and resonant capacitor (C) across one end of each tube filament. The resulting current through the resonant capacitor heats up the tube filaments and allows the tube to fire.

The circuit then changes to a different operating mode. Inductor L limits the current to the tube and the operating frequency becomes lower as set by a saturable transformer. The AC capacitor is used to prevent DC being applied to the tube. DC can cause mercury migration to one end of the tube which will ultimately reduce the operating life.

Circuit details

The full circuit for the fluorescent inverter is shown in Fig.2. At the heart of the DC-DC converter is IC1, a TL494 pulse width modulation (PWM) controller. It contains a sawtooth oscillator, two error amplifiers and a pulse width modulation comparator. It also includes a "dead time" control comparator, a 5V reference and output control options for push-pull or single ended operation.

Oscillator components at pins 5 and 6 set the operating frequency of the pulse width control at about 120kHz. This frequency was selected to obtain the maximum power output from the transformer. The PWM controller generates variable width output pulses at pins 9 and 10, to ultimately drive the gates of Mosfets Q1 and Q2 via paralleled buffers in IC2.

Mosfets Q1 and Q2 drive the centre tapped primary winding of transformer T1. The centre-tap of the transformer's primary winding connects to the +12V supply while each side of the primary winding is connected to a separate Mosfet. Each Mosfet is driven with a square wave signal so that when Q1 is on, Q2 is off and when Q2 is on, Q1 is off.

With Q1 on, 12V is applied to the top half of the transformer primary winding. Because of transformer action, the lower half of the transformer primary winding also has 12V across it. Similarly, when Q2 turns on, 12V

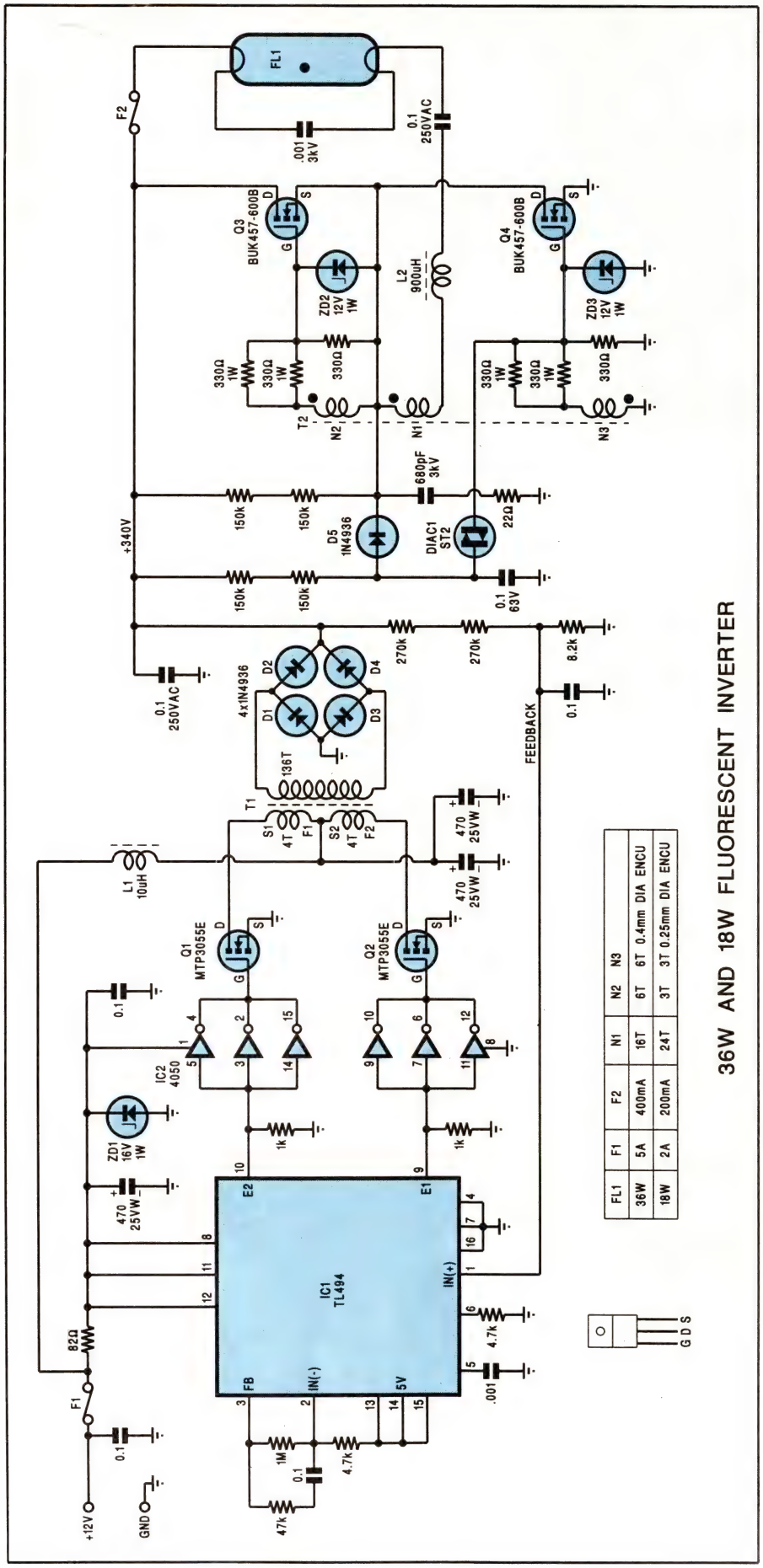


Fig.2: the complete circuit of the fluorescent inverter. The DC-DC inverter section runs at about 120kH while the fluorescent driver section runs at 65kHz for 36W tubes and 110kHz for 18W tubes.

is also impressed across the top pr mary winding. The resulting 24 peak-to-peak waveform on the prima is then stepped up by the secondai winding.

High speed diodes D1-D4 rectif the AC output from transformer T while a 0.1µF 250VAC capacitor fi ters the rectifier output to provide stable voltage. We can get away wit such a small value filter capacitor her because the operating frequency is s high.

Feedback

Feedback from the high voltage DC output is derived from a resistive di vider (two 270kΩ and an 8.2kΩ resis tor) and applied to the internal erro amplifier in IC1 at pin 1. If the DC voltage becomes greater than 340V, the pulse width drive to the Mosfets is reduced until the correct voltage is obtained. Similarly, if the voltage drops below 340V, the pulse width is increased until the correct voltage is achieved.

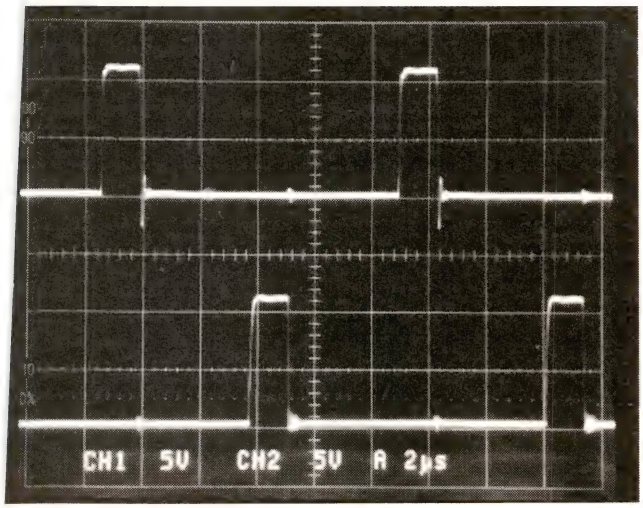
The DC gain of the error amplifier is 213 times, as set by the 1MΩ and 4.7kΩ resistors at pin 2. The 47kΩ resistor and 0.1µF capacitor across the 1MΩ feedback resistor provide fast AC response from the circuit.

Power to IC1 and IC2 is supplied via an 82Ω resistor from the +12V battery supply and filtered with a 470µF capacitor. A 16V zener diode protects the circuit from high voltage transients.

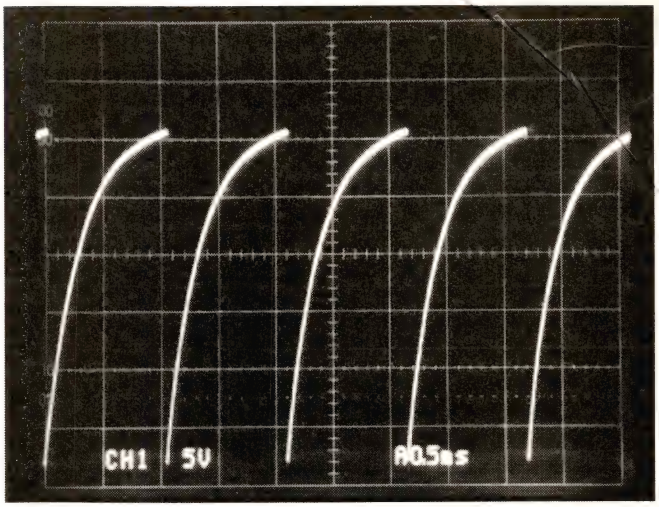
To eliminate RF noise generated by the switchmode DC-DC converter from being radiated by the supply leads we have included a filter comprising inductor L1 and a 0.1µF capacitor (at the input).

Fluorescent driver

The fluorescent tube driver comprises Mosfets Q3 and Q4, transformer T2 and associated components. The fluorescent tube is driven via inductor L2 and the N1 winding of trans-



his photo shows the gate drive pulses to Q1 & Q2 in the C-DC converter when driving an 18W tube. The gate ulse width will be greater when the circuit is driving a 6W fluorescent lamp.



These are the starting pulses present at the drain of Q4 with no tube in circuit. Pulses from Diac1 drive the base of Q4 and switch it on. Note that a 10:1 probe was used for this measurement.

ormer T2. The N1 winding drives the ates of the Q3 and Q4 Mosfets via the J2 and N3 windings which are ntiphase connected.

When power is first applied, there s 340V DC between the drain of Q3 nd the source of Q4. The 0.1µF capacitor adjacent to Diac1 begins to charge via the two series 150kΩ resistors. When the voltage reaches about 30V, the Diac fires and discharges into the gate of Q4. Zener diode ZD3 protects the gate from overvoltage.

Mosfet Q4 is now switched on and current can flow from the +340V supply via the fluorescent tube top filament, the .001µF 3kV capacitor, the second tube filament, the 0.1µF 250VAC capacitor, inductor L2 and transformer T2's N1 winding. Current flow in N1 will then apply gate drive to Q3 via N2 and switch off gate drive to Q4 via N3 (due to the polarity of the windings).

If this oscillation does not occur, the 0.1µF capacitor again charges up and the Diac fires to switch on Q4 again. Ultimately, oscillation will occur with Q3 and Q4 switching on and off in alternate fashion. The frequency of operation is set by the combined inductance of L2 and the N1 winding and the .001µF capacitor across fluorescent tube FL1.

The oscillator current now passes through the fluorescent tube's filaments and allows the normal mercury discharge to take place inside the tube. When this happens, the .001µF capacitor across the tube is effectively shunted out by the mercury discharge. This takes place at a peak voltage of about 100 volts.

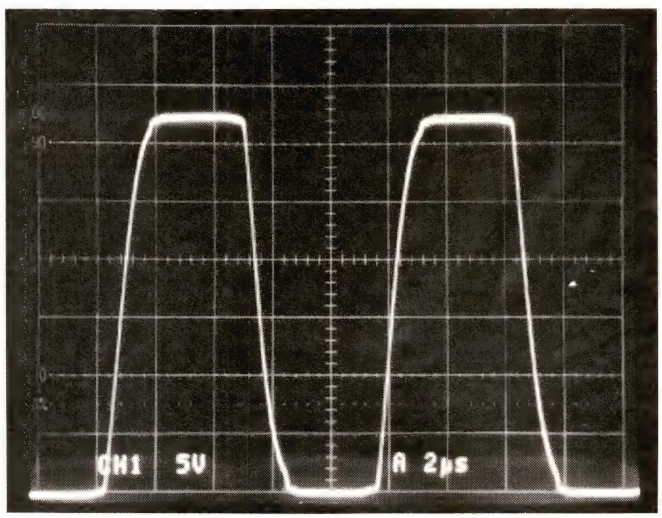
The frequency of oscillation is now determined by the properties of the core of transformer T2. As the current builds up in winding N1, the core begins to saturate. When this happens, the flux in the core stops changing and the gate drive to Q3 or Q4 ceases. The flux now collapses to drive the opposite Mosfet and this process continues to maintain oscillation. Current through the tube is limited by the current at which the T2 core saturates and the L2 inductance. These two components provide the same current limiting function for the tube as does the ballast in a conventional fluorescent lamp fitting, except that the frequency is many times higher than 50Hz.

The start-up circuit, comprising the 0.1µF capacitor and Diac1, is prevented from interfering with the normal operation of the circuit by diode D5. The diode discharges the 0.1µF capacitor every time Q4 is switched on, thus preventing the Diac from firing.

The gate drive to Q3 and Q4 is limited using two parallel 330Ω gate resistors and 12V zener diodes which clamp the gate voltage to a safe value for the Mosfets. The 330Ω resistor from gate to source provides a load for transformer T2 so that the saturation characteristic for the core can be accurately set.

Note that while Mosfets Q1 and Q2 in the DC to DC converter are fitted with heatsinks, Q3 and Q4 switch only small currents and therefore they do not require heatsinks. However, during the switch-over process, when one Mosfet is switched off and the other turns on, the Mosfet which is turned

This is the waveform at the drain of Q4 when driving an 18W tube. The overall amplitude is 330V peak to peak & the frequency is 110kHz.



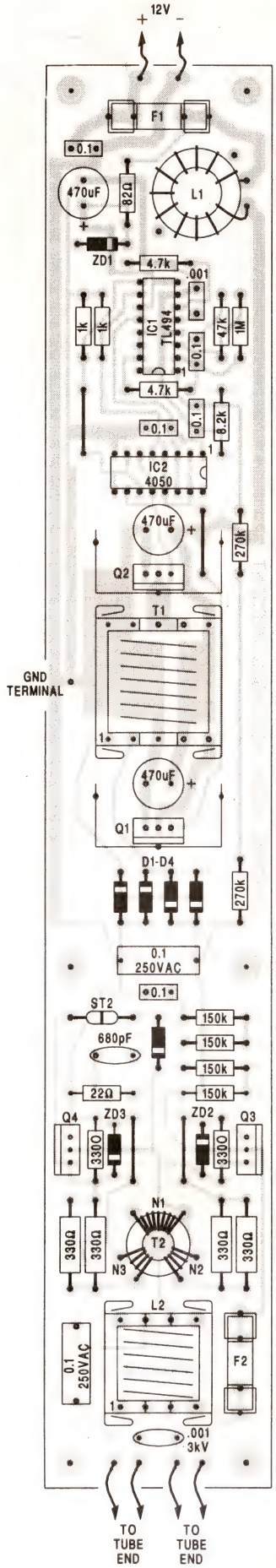


Fig.3: the PC board layout. Note that transistors Q1 & Q2 are fitted with heatsinks & note also that high voltages are present on the board when power is applied.

off commutates whereby its internal reverse diode briefly conducts. This commutation can lead to high dissipation in the Mosfets. To reduce this dissipation to almost zero we have connected a snubber network to the output (ie, the junction of Q3 and Q4). The snubber network consists of a 680pF capacitor in series with a 22Ω resistor.

The two 150kΩ resistors connecting from the 680pF capacitor to the +340V supply act as a load for the circuit if the fluorescent tube is not present.

Circuit changes

There are a few changes to be made to the circuit, depending on whether it is to be used with an 18W or 36W fluorescent tube. These are shown in the table on the circuit. The input fuse (F1) is 2A or 5A and the winding details of transformer T2 are varied. The reason why transformer T2's windings are varied is to vary the frequency of the fluorescent driver circuit and thereby set the current through the tube. For 18W tubes the frequency is 110kHz and for 36W tubes the frequency is about 65kHz. While the frequency for the 36W tube is not quite halved, the changes to transformer T2, combined with the fixed inductance of L2, means that the current is doubled.

High frequency operation

Before concluding the circuit description, we should make a comment about operating fluorescent tubes high frequencies. In some technic literature, fluorescent tubes are state to be much more efficient at high fr quencies. This is not true. There ma be a small difference between oper tion at 50Hz and, say, 1kHz but abov that, the light output from a fluore cent tube is directly proportional t the current through it, although ther are limiting factors above which th tube becomes overheated and its lif is shortened. Therefore, the efficienc of the circuit is much the same for th 18W and 36W tube versions of th circuit, regardless of the fact that th operating frequencies are different.

Note also that the 18W version o the circuit will work with a 20W tube and the 36W version will work with a 40W tube. The slightly higher rated (and thicker) tubes have the benefit that they are easier to start but they are more expensive.

We should also make some comments about the circuit efficiency. We have set the current through the respective 18W and 36W fluorescent tubes to be close to the value it would be if running in a conventional 50Hz ballast circuit. This results in the 18W version of the circuit drawing 1.5 amps

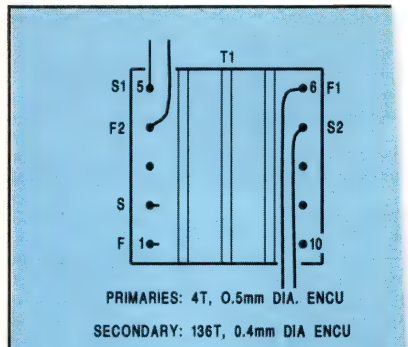
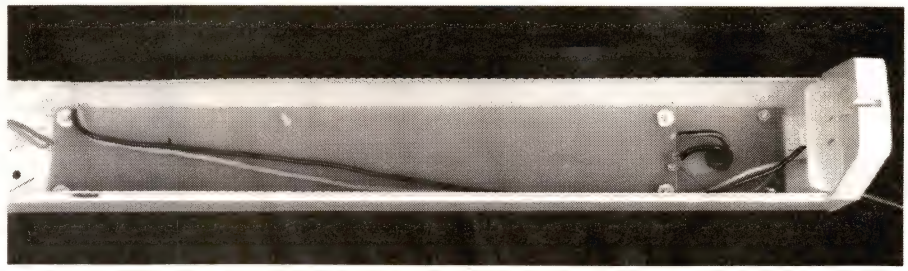


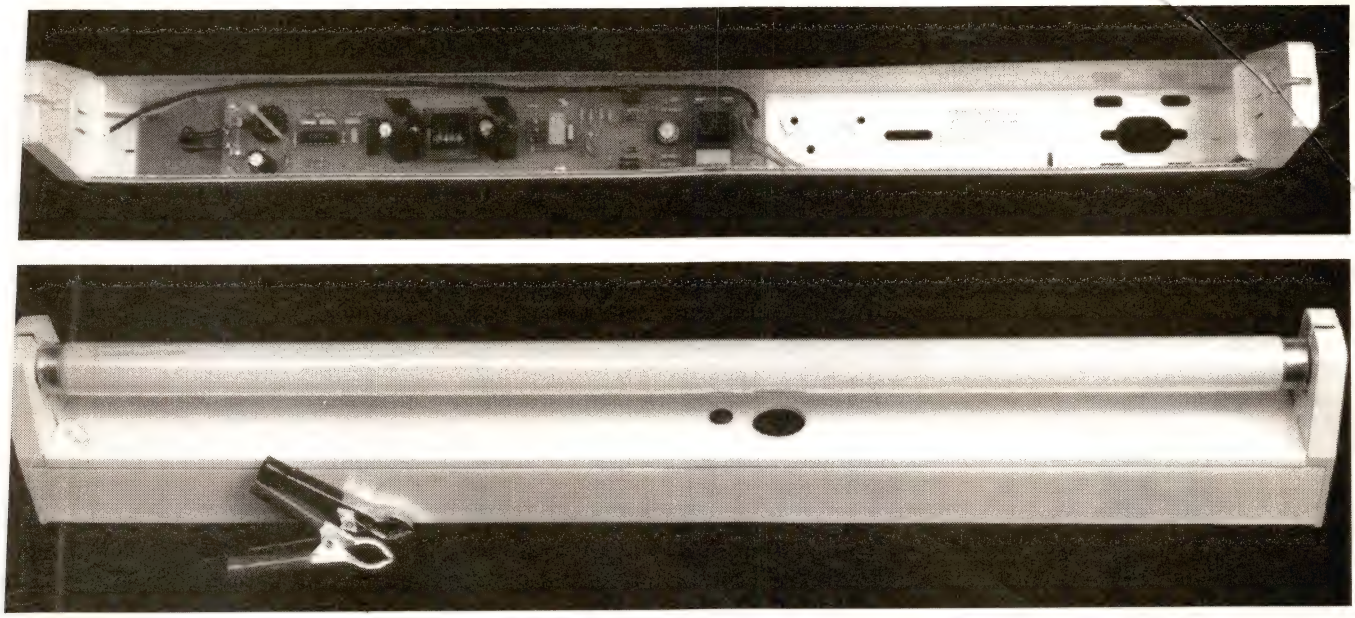
Fig.4: the winding details for transformer T1. Note that the primary windings are bifilar.

WARNING!

This project develops potentially lethal voltages. At no time should any part of the circuit be touched while power is applied. This project should not be attempted by inexperienced constructors.



A piece of blank PC board material is used to prevent direct contact with the underside of the components board through the large cutouts in the batten base. The hole for the starter (in the batten cover) should also be sealed.



he assembled PC board fits neatly in one end of the batten, as shown in the hotograph at top. Make sure that the board is properly secured before fitting ıe cover & the fluorescent lamp.

rom a 12V supply and the 36W ver-ion drawing 3 amps from a 12V sup-ɔly.

Does this make the circuit 100% efficient? The answer is clearly no since an 18W fluorescent tube does not dissipate 18 watts – a significant amount of power in an 18W fitting is dissipated by the ballast. Hence, while we cannot quantify the overall circuit efficiency, we can state that it is quite high and certainly higher than other inverter designs intended for driving fluorescent tubes. Our estimate of the efficiency is "better than 80%".

Construction

The PC board for the circuit is coded 11312931 and measures 286 x 46mm. It will fit inside a standard 18W or 36W fluorescent tube batten.

Construction can begin by winding the toroids and the transformers. Let's start with L1, the larger of the two toroids and brown in colour. Wind on 18 turns of 0.8mm enamelled copper wire with even spacing around the toroid.

L2 is not a toroid but is the smaller ferrite assembly comprising a bobbin, two core halves and two clips. Before winding this you will need to set the gap in the centre leg of the core halves. You will need a small file (a points or hobby sized file would be ideal) and a set of feeler gauges.

Initially, place the two core halves together and observe that there is no gap between the mating surfaces of the core halves. Now file only the centre leg of one core half, making sure that you are filing squarely and evenly across the face. The required gap is 0.15mm and can be accurately measured with feeler gauges when the two halves are held together with your fingers. The whole process should not take longer than 5 minutes since the ferrite material is quite soft.

Now wind 60 turns of 0.4mm enamelled copper wire onto the bobbin, with the start end soldered to pin 6. Wind each layer neatly side by side across the bobbin and insulate between each layer with a length of insulating tape. Solder the end of the winding to pin 7 on the bobbin. The inductor can then be completed by fitting the core halves into the bobbin and securing them with the clips.

Transformer T1 is the larger of the two ferrite assemblies. The ferrite cores should not be gapped in this case since we want the gap to remain at

RESISTOR COLOUR CODES

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	1MΩ	brown black green brown	brown black black yellow brown
❑	2	270kΩ	red violet yellow brown	red violet black orange brown
❑	4	150kΩ	brown green yellow brown	brown green black orange brown
❑	1	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	1	8.2kΩ	grey red red brown	grey red black brown brown
❑	2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	2	1kΩ	brown black red brown	brown black black brown brown
❑	2	330Ω	orange orange brown brown	orange orange black black brown
❑	1	82Ω	grey red black brown	grey red black gold brown
❑	1	22Ω	red red black brown	red red black gold brown

zero. Fig.4 shows the winding details. Wind on the secondary first using 0.4mm enamelled copper wire. Terminate the start of the winding at pin 2 and neatly wind on one layer of wire across the bobbin. Insulate this with a layer of insulating tape.

Note here that the start and finish of the insulating tape should begin on the underside of the bobbin (ie, the pin side of the bobbin). This will ensure that the ferrite core halves will fit over the completed windings. Continue winding until 136 turns have been wound on in several layers with insulation tape over each layer. Terminate the finish of the winding at pin 1.

The two primary windings are wound bifilar (ie, two wires at the same time), with one end of each winding starting at pins 4 and 5 and finishing at pins 6 and 7, respectively. Wind on four turns, making sure that the two windings do not cross over each other. Note that there will not be sufficient room to cover the windings with insulation tape. These windings can be clearly seen in one of the photos accompanying this article.

When the bobbin is completed, fit the core halves and the retaining clips.

Toroid T2 is wound as detailed in the table on the circuit diagram (Fig.2). If you are making the 36W version, use 0.4mm enamelled copper wire. If you are making the 18W version, use 0.25mm enamelled copper wire. Wind on the N1 winding, keeping the windings tightly packed toward one side of the toroid. The N2 and N3 windings must be wound in the same direction as the N1 winding.

With the transformers and inductors complete, assembly of the PC board can proceed. Before installing components, check the board for shorts or breaks in the tracks. Also check the holes for correct sizing for each c ponent. You will need 3mm holes the PC board mounting, transfor T2 and for the heatsink mounting f Two 3mm holes are also required f cable tie to hold down L1.

Start the board assembly by ins ing all the PC stakes plus the four 2. fuse clips. This done, insert the re tors, links and diodes, followed the two ICs. Make sure that the dio and ICs are correctly oriented bef soldering. The same comment appl to the electrolytic capacitors. The S (Diac1) can be installed either w around.

Now install transformer T1 and i ductor L1 onto the PC board, taki care that pin 1 marked on the bobb is oriented correctly. Transformer T is mounted using a transistor moun ing bush together with a Nylon scre and nut. L1 is held in position using small plastic cable tie.

Mosfets Q1 and Q2 are fitted wit small vertical heatsinks using machin screws and nuts. Apply a smear c heatsink compound to the mating su faces before screwing the Mosfet bod

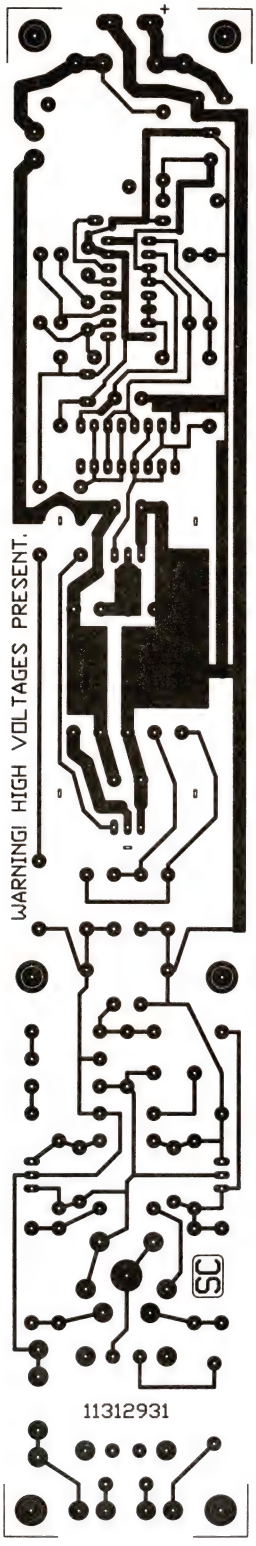
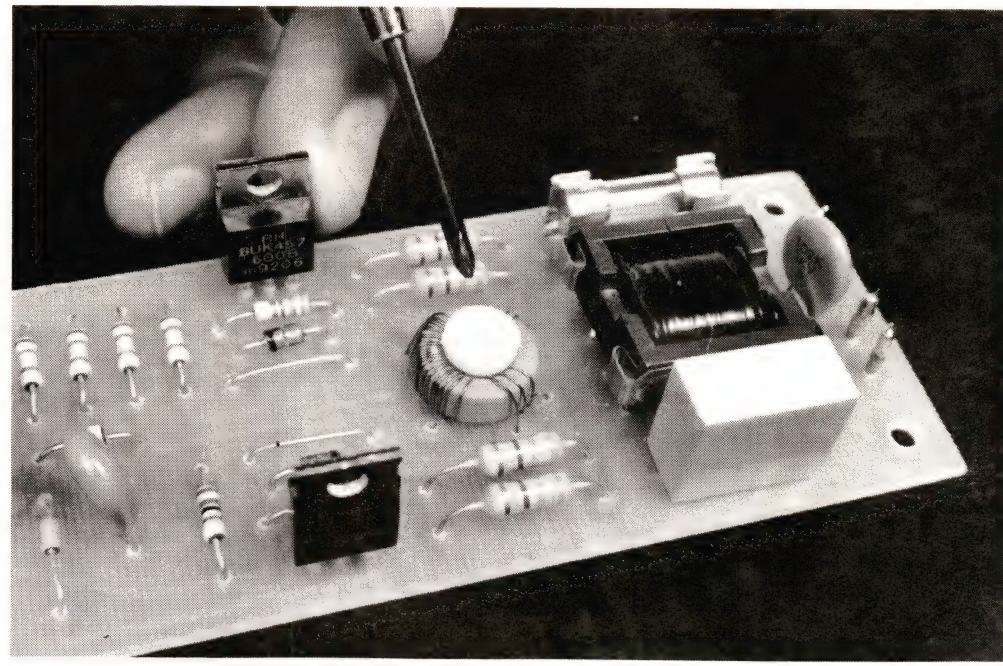


Fig.5: this is the PC artwork reduced to 70.7%. To reproduce it full size, use a photocopier with an expansion ratio of 1.41.

Below: this close-up view shows how transformer T2 is secured to the PC board using a Nylon screw, a transistor insulating bush & a nut. Coil L1 at the other end of the board is secured using a plastic cable tie. Be sure to install Q3 & Q4 with their metal tabs adjacent to the edge of the board.



e heatsink. Each heatsink is se-
d using the integral mounting feet
:h pass through the holes in the
oard. When they are inserted into
)oard, use a pair of pliers to twist
feet and hence lock them into the
:d. This done, solder the Mosfet
ıs to the copper pattern. Mosfets
and Q4 can also be mounted at
stage – they do not require heat-
ks.
inally, fit the fuses into the fuse
)s and the board is complete.

ıtallation

We recommend that the PC board
installed into the fluorescent bat-
before testing, because the voltages
veloped by the circuit are poten-
lly lethal.
Before installation, the existing bal-
ıt, starter and terminal strip will
ed to be removed from the fluores-
nt batten. Now drill holes to accom-
)date the PC board and drill out a
)le for the cord grip grommet suit-
)le for the 12V lead entry.
We mounted the board on top of a
ece of blank PC board material to
)ver the copper tracks (any other
ınsulating material would do), while
ıe hole for the starter was covered
sing a piece of plastic and a metal
lip. This will prevent direct contact
/ith the underside of the PC board
ırough the large cutouts in the batten
ase and cover. The board mounts
nto transistor mounting bushes, used
ıere as low profile spacers, and is
ecured at six points with screws and
ıuts.

Connect up a length of polarised
win-lead to the 12V input and con-
ıect the wires from the tube ends to
:he PC board as shown on the wiring
diagram. The negative terminal of the
PC board is connected to chassis us-
ing a short piece of hook-up wire sol-
dered to a solder lug.

Testing

Once the PC board has been in-
stalled in the batten, you are ready for
testing. Insert a fluorescent tube into
the fitting and apply power. The tube
should initially glow with a bluish
tinge for a half second or so and then
come on with full brilliance. There
should be no flicking during the start-
up phase (as is the case with normal
fluorescent lights) and there should
be no discernible flicker at all once
the tube is at full brilliance.

PARTS LIST

1 PC board, code 11312931, 286 x 46mm
1 blank PC board, 336 x 46mm
1 18W or 36W fluorescent tube batten
1 EFD25/13/9 3F3 core (no air gap), former and clips (2 x Philips 4312 020 4116 1, 1 x 4322 021 3524 1, 2 x 4322 021 3516 1) – T1
1 RCC12.5/7.5/5 3F3 ring core (1 x Philips 4330 030 3792 1) (T2)
1 RCC17.1/9.8/4.4 2P90 ring core (1 x Philips 4330 030 6031 2) – L1
1 EFD20/10/7 3F3 core, former and clips (2 x Philips 4312 020 4108 1, 1 x 4322 021 3522 1, 2 x 4322 021 3515 1) – L2
2 battery clips (1 red, 1 black)
2 vertical mount TO-220 heatsinks (Jaycar Cat. HH-8504)
4 2AG PC mount fuse clips
1 5A 2AG fuse (36W version)
1 2A 2AG fuse (18W version)
1 400mA 2AG fuse (36W version)
1 200mA 2AG fuse (18W version)
1 cord grip grommet
7 transistor mounting bushes (6 for 4mm PC board standoffs)
1 3mm Nylon screw and nut
1 small cable tie
2 3mm dia x 6mm long screws & nuts
8 3mm dia x 12mm long screws, nuts & washers
1 solder lug
1 80mm length of 0.8mm tinned copper wire
1 600mm length of 0.8mm enamelled copper wire
1 10.5m length of 0.4mm enamelled copper wire
1 500mm length of 0.5mm enamelled copper wire
1 800mm length of 0.25mm enamelled copper wire
1 2m length of twin automotive wire (polarised)
7 PC stakes

Semiconductors
1 TL494 switchmode IC (IC1)
1 4050 CMOS hex buffer (IC2)
2 MTP3055E avalanche protected N-channel Mosfets (Q1,Q2)
2 BUK455-600A, BUK457-600B high voltage N-channel Mosfets (Q3,Q4)
5 1N4936 fast recovery diodes (D1-D5)
1 ST2 Diac (DIAC1)
1 16V 1W zener diode (ZD1)
2 12V 1W zener diodes (ZD2, ZD3)

Capacitors
3 470µF 25VW PC electrolytic
2 0.1µF 250VAC metallised polypropylene
5 0.1µF MKT polyester
1 .001µF MKT polyester
1 .001µF 3kV
1 680pF 3kV

Resistors (0.25W, 1%)

1 1MΩ	2 1kΩ
2 270kΩ	4 330Ω 1W
4 150kΩ	2 330Ω
1 47kΩ	1 82Ω
1 8.2kΩ	1 22Ω
2 4.7kΩ	

If the inverter does not power up the fluorescent tube, switch off power immediately and check for faults. Check that all the components are located correctly and that the transformers and inductors are wound and oriented correctly. Transformer T2 must be wound with correct phasing or the oscillator will not function.

You can check that the DC-DC converter is functioning by measuring the voltage between the GND terminal and F2 fuseholder. It should be 340V DC. Use your multimeter set to read 1000VDC and check that the multimeter probes are in good condition before making this measurement. The voltage is potentially lethal.

Further tests can be made using an oscilloscope. You must connect the oscilloscope probe earth connection to the GND terminal on the PC board. Keep your probe set on 10:1. You should be able to see the starting pulses applied to Q4, by measuring the waveform at the drain (metal tab) of Q4 when the tube is out of circuit. The oscillation should be observed at Q4's drain when the tube is installed (see oscilloscope photographs). SC

SERVICEMAN'S LOG

Working within the customer's budget

With smaller sets, the cost of any repairs must be kept under control. My main story this month is a good demonstation of that & is also an excellent example of how a minor component can cause inconvenience.

The story concerns a Hanimex colour TV set, model CTV-10. It is a semi-portable type, with a 25cm screen, and is designed to operate from either 240V AC or 12V DC (eg, from a car battery). And it is around this dual operation feature that the story revolves.

The owner had bought it when he retired, primarily for use in his caravan on a round-Australia trip which lasted some 12 months. And, as can be imagined, the 12V system came in for a fair amount of use during that time.

But shortly after returning home, he realised that the 12V system could no longer be used, although the set continued to perform perfectly well on 240V. Well, that wasn't much of a bind; they were not planning any long caravan trips in the future and, as long it functioned on the mains, it would suit their needs quite well.

So that was how things went for the next 12 months or so. In fact, it would probably have continued along these lines indefinitely, if the set had not also failed on the mains. And that's where I came in.

The owner was a new customer and he set out the above history before asking the vital question, "Can you fix it?" I couldn't be sure, of course. As I explained to him, it was a set I hadn't seen before and I had no circuit or service manual. Hopefully, I could get data from Hanimex if necessary but, initially, I would simply look for what was obvious.

Filthy lucre

That was OK but then came the vital question of filthy lucre; how much was he prepared to spend on it? It was an important question because I didn't know what I would find or what data or spare parts were available.

After some discussion, we settled on a figure of $100. If it looked like exceeding that figure, I would consult him first.

And so he left it with me. On closer examination, I learned that the set was made in China. Later, when I delved into the innards, I wasn't all that impressed with the construction in general. I'd seen worse but I'd seen better too.

At a more basic level, I had to try to work out the power supply system and decide where to start looking. The only thing I felt reasonably sure about was that there were two sep rate faults, since the two failures h occurred at different times.

As it turned out, the set was ba cally a 12V device, with the additi of a 12V mains-driven power suppl The mains cord was fitted perm nently, while the 12V cord connecte to the set via a plug and socket a rangement.

There was no switching involve The 12V positive battery lead wer straight to the 12V rail derived fro the mains power supply. The voltag regulator IC isolated the 12V from th rest of the supply circuitry – quite a elegant system.

It was the plug and socket arrange ment connecting the 12V lead to th set that provided the first clue. It is commonly used fitting, typically re ferred to as a DC power plug or DC jack – with matching socket. The plug which fits on the cable, is a female fitting, and the socket, normally chassis mounted, is the male version.

When I tried to push the plug into the socket it wouldn't fit properly. Closer examination revealed that the end of the plug had been damaged. The insulation between the inner and outer conductors was deformed, as was the end of the inner conductor.

Thus alerted, I pulled the back off the set for a closer examination of the socket. And this was the real culprit; it had obviously been seriously over-

TC-48P10 Has Live Chassi

In the Serviceman story in the October 1993 issue, I mentioned that the Panasonic TC-48P10 and by implication the TC-1480A had an M15D "dead" chassis. This is wrong – both sets have the M15L "live" chassis. The mistake has come about partly because I test and repair all sets using an isolation transformer.

Spectrum Analysis..

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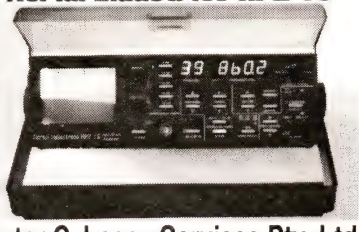

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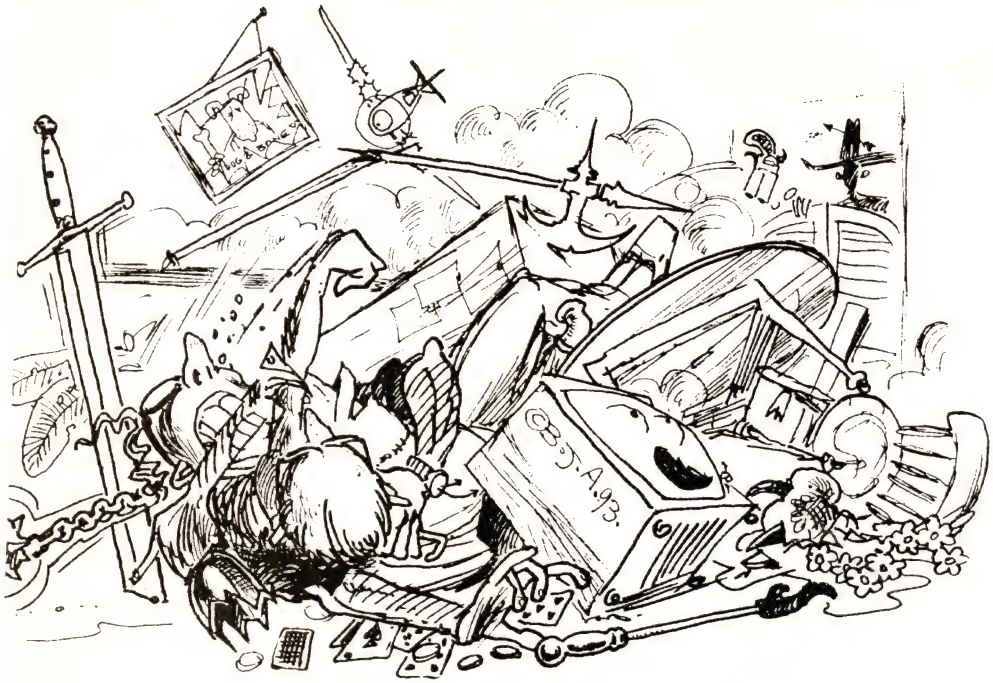


AFTER SOME DISCUSSION, WE SETTLED ON A FIGURE OF $100...

eated and was grossly deformed. I ıbsequently measured the current ıvolved and it varied from 2.25A to .5A over the range 12-13.8V. That's retty solid for a miniature connector .ke this, particularly as the set would ypically run for quite long periods.

As a quick test, I patched a couple ıf leads into the circuit and connected hem to the 12V bench power supply. And the set sprang to life immediıtely, with good sound and a first-:lass picture. I gave it a quick check ıcross all the channels and satisfied myself that there was nothing wrong with its operation. This clearly suggested that its failure to operate on 240V must involve the power supply.

In the meantime, what was to be done about the damaged connectors? The easy way out would be to simply replace them with new units of the same design. However, knowing that they appeared to be inadequate, at least on a long-term basis, should I try to fit something better?

I mulled over this latter idea at some length and was eventually forced to the conclusion that, desirable though it might be in theory, it was not physically practical. It would have meant hacking into the chassis in an awkward spot, could not have been done neatly, and would have only added to the cost. I even discussed the problem with the owner and he agreed that it was unlikely that the 12V system would get much use from now on.

So I took the easy way out. But why wasn't the set designed to take an adequate plug and socket – even if it cost a fraction more?

The supply fault

Putting such questions aside, I now had to find the fault in the mains supply. It was a simple circuit, consisting of a power transformer delivering around 16V, a bridge rectifier, a 3-terminal voltage regulator and a filter capacitor.

It didn't take long to pinpoint the culprit – the transformer primary was open circuit. It was a simple job to remove the transformer and, when I did, it revealed a small sticker saying, "Internal Thermal Fuse". So my guess is that it was this that had failed but for what reason we will never know. In any case, the transformer was a write-off.

So where to from here? There were two points to be clarified: (1) the availability of a replacement and (2) the cost. This latter point was most important. Transformers are not cheap and I could see that, with labour costs, the $100 limit might be exceeded.

So it was back to the customer. I had to be honest and point out that, depending on the best transformer deal I could swing, the job might cost up to $150. Was he prepared to go that far? He wasn't too keen at first but I pointed out that we knew the set itself was OK, performed well, and that to replace it, would probably set him back $300 to $350. So, after some hesitation, he agreed.

So began the search for the best transformer deal. My first choice was a Samsung unit I had on hand. It was electrically suitable, was fitted with a magnetic shield similar to the original, and looked as though it would fit physically. And, most importantly, it only cost me $36, including tax. At that price, I could do the job well under the limit.

But alas for my clever thought; it was just marginally too large and there was no way I could fit it. So the next step was a call to the Hanimex spare parts department. It was a good news/bad news situation. Yes, they could supply a transformer ex-stock but the price was $73 plus tax, or about $95. Pack and post would add another $6, giving a total of about $100. I said "Ouch" under my breath and thanked them for their help.

That simply was not a proposition. Even without any mark-up on the transformer, labour costs – including the work done on the 12V system – would put the total above the agreed figure. And I couldn't justify pushing the limit any higher. I had to find a better way.

Substitute transformer

A colleague dropped in for a chat around this time and I filled him in on the problem, displaying the faulty transformer. His reaction was immediate: "Have a look at an old Akai video recorder, a VS-3 or VS-4. They had a transformer with a number of windings on it and it might just fit."

Being thus reminded, I realised that he could be right and that I might just have one. So it was out to the junk room where we scrabbled through the discards and, sure enough, there was a junked VS-3. So it was back to the bench and out came the transformer.

And it looked quite promising, being of a shape and size which would clearly fit. All that remained was to

sort out the secondary windings and, hopefully, find one that would suit. The primary winding was easily identified, so the quickest way was to fit a power cord and plug it into the mains.

Unfortunately this proved to be another setback. At switch-on there was a protesting splat and a puff of smoke; storage had apparently not been kind to this device and it was write off.

But the exercise had not been completely wasted. My colleague had started a useful train of thought and I remembered another Akai video recorder in the junk room, this time a VS-112 which is a much later model. And again, the transformer looked very promising. It was smaller that the VS-3 unit and should fit easily.

In fact, when I pulled it out and tried it in position, I realised that I could bolt it directly into place; a real win. So another mains test was set up. And it didn't go splat this time. More importantly, it had three secondary windings, one at 30V and two at 16V, the latter being the more useful value.

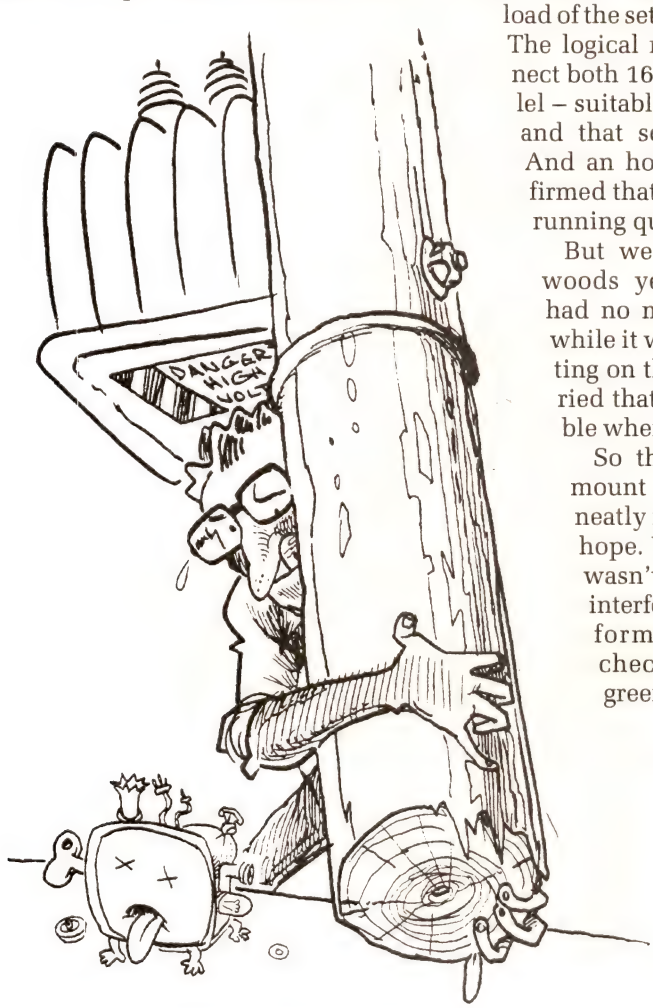
Initially, I sat the transformer on the bench and patched one of the 16V windings into the circuit for a trial run. And it worked but with one reservation; the DC voltage out was barely holding its value. I plugged it into the Variac and reduced the input voltage slightly. Sure enough the picture started to bend and pull. In short, there was not quite enough voltage at the regulator input to cope with line voltage variations.

The 16V AC should have been enough but I sensed that the winding was a rather light one and that the load of the set was pulling it down. The logical reaction was to connect both 16V windings in parallel – suitably phased of course – and that solved that problem. And an hour's bench test confirmed that the transformer was running quite cool.

But we weren't out of the woods yet. The transformer had no magnetic shield and, while it worked fine when sitting on the bench, I was worried that it could cause trouble when mounted in the set.

So the next step was to mount it in the set, wire it neatly in the final form, and hope. Well, we won. There wasn't the slightest hint of interference from the transformer, even when checked on blank red, green and blue rasters. I gave the set a soak test on a daily l for about a week before finally d ering it to the customer.

So what did it all cost? I cha him $125. Yes, I know, the transfor didn't cost me anything – well nc hard cash – but it did cost me a lc time, taking into account the prob with the first unit. So I reckone was a fair price. The customer thou so too; he was delighted.



~THE TRANSFORMER LOOKED QUITE PROMISING, BEING OF A SHAPE AND SIZE WHICH WOULD CLEARLY FIT...

A day in the life ...

And now, for a change of scen and a change of pace – here are so short stories from my colleague J. across Bass Strait. He has sent m number of such items and I am cluding as many as space will perr this time around. More next time. O to you, J. L.

The stories selected for this c umn are usually about unusual faul or about common faults that requi some kind of mental gymnastics resolve.

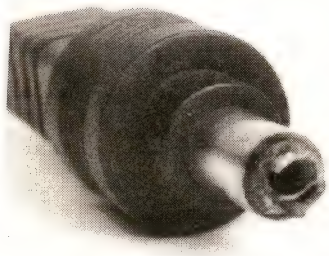
The simple faults, like replacing shorted chopper transistor and t resulting blown fuse, never seem make these pages. Yet they constitu 99% of all jobs passing through th average serviceman's workshop.

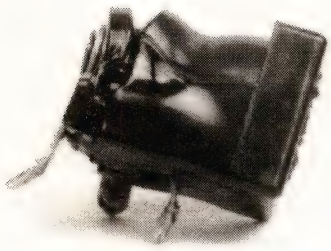
There are times when I have a lon run of routine tasks that provide n inspiration for Serviceman stories an I'm left bereft of any material to writ about. So, at the suggestion of th Editor, I have decided to put togethe a list of common but interesting faults

One that I have just finished was ar AWA video recorder, an AV47. It came in with the complaint that it "would not play through the TV set". This was a rather ambiguous statement, since it could mean that it would not feed playback signals to the TV set, or it could mean that it would not pass off-air signals as well.

The only thing to do in a case like this is to set the machine up and operate it in the way an average owner might drive it. This is not as easy as it seems, since a technician usually knows what the "TV/VCR" switch and other controls mean and would be expected to put them in the correct position.

To operate a VCR in "average citizen" mode means that the serviceman has to try to forget everything he has ever learned about these devices. Then, with any luck, he will hit on the same problem as the customer did





is close-up view shows the heat-damaged DC plug & socket from the nimex CTV-10 12V supply system.

d be able to diagnose the fault raight away.

In this case, I was lucky. I connected the machine to the bench monir and tuned one to the other. The f-air picture was decidedly snowy ıd the off-tape picture was also exemely poor. It was snowy, had no olour and often rolled.

I recorded a few minutes of proram material and then played it back n another machine. The results eemed to be reasonable but I did letect some snowy scenes. It was not vhat I would have called a prime uality picture.

3ooster/modulator unit

A glance at the circuit diagram in he service manual showed that both he antenna booster and the output modulator were contained in a single unit. I had a horrible suspicion that this was the source of the trouble.

By attaching a test tuner I was able to determine that the output of the booster was far from up to scratch. In fact, there was far less signal coming out of the booster than there was going into it.

Similarly, I was able to feed a good video signal into the modulator part of the unit and found the output to be far less than one would have expected. There is no circuit diagram published for the booster/modulator unit but I would hazard a guess that some part of the supply rail to the chips inside the unit had failed.

Unfortunately, there is no way to repair these devices so I had to place an order for a new one from Mitsubishi AWA. It wasn't cheap but the new unit cured all the problems and so the customer is satisfied with the result, if not really happy about the cost.

The next job was a Sharp VC-8300X VCR, one of the first of Sharp's front loading models. The problem here was that the machine would load and begin to play but then shut down before it showed any sign of a picture.

I took the cover off the machine and tried again to play a tape. The cause of the trouble was immediately apparent. The drum was not rotating.

The drum motor in this machine is not one of those modern direct drive types. It consists of a very conventional brush type motor, driving the drum by means of a wide flat belt.

It didn't take long to discover that the motor was being provided with a healthy drive voltage yet showed no signs of life. I disconnected the leads from the motor and tested it for continuity. There was none.

The VC-8300X is a very old machine and probably not worth all that much. I checked with the owner to see if he was prepared to pay something like $80 for a new motor. He wasn't, so we decided that the machine would probably have to be junked.

But before taking that step, I enquired among some of my colleagues who have a stock of junk sets in their store rooms. One of them did have an 8300 and it had a seemingly good motor on the deck. We struck a quick deal and I took the motor off the wreck.

I had the motor fitted and the machine up and running just 15 minutes after my return to the workshop. The owner was quite happy to have a secondhand motor fitted to his machine. The alternative would have been very much more expensive.

(I later found that one of the brush springs in the original motor had been bent slightly, thus holding the brush away from the commutator. I might have been able to repair it but as I had already fitted the replacement there was no point).

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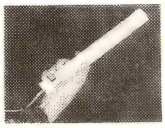

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The next job involved another mechanical problem, this time in a Sharp cassette deck. I plugged in a set of headphones, dropped my test cassette into the deck and pressed play. The sound in the phones was hardly recognisable. It was suffering from the most hideous warble I have ever heard.

When I looked inside the cassette well, my eye was immediately caught by a large dollop of black gloop on the capstan shaft. In fact, it turned out to be a part of the pinch roller. What had happened was that the roller rubber had perished and become very soft and sticky. Part of it had torn off and stuck to the capstan.

The job was relatively easy to fix. I first had to work out how to remove the pinch roller arm before I could remove the roller spindle. After that, I had to find out if I could get a proper replacement. In the event, I found an alternative in a junked deck so once again the customer scored a quick fix at a reasonable price.

Thank you J. L. I like the idea of dealing with the more mundane, day-to-day, bread-and-butter jobs; it helps strike a balance. More next time. **SC**

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S0310	100W dynamic class a main power amplifier mono	9
S0313	100W fully symmetrical class a power amplifier mono	9
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S0329	120W mosfet power amplifier	20
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S0331	300W HQ Power Amplifier	20
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S0334	6W Mini Mono Amplifer	19
S0335	12W Stereo Power Amplifier	37
S0336	30W Amp with Tone Control and Mic. Input	42
S0337	30 + 30W High Quality Stereo Amplifier	77
S0338	40W PA Amplifier with 3-way Tone Control	58
S0339	40 + 40W OCL Power Booster	59
S0340	140W Modified Class A Main Power Amplifier	169
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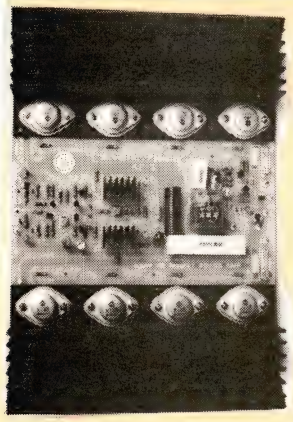
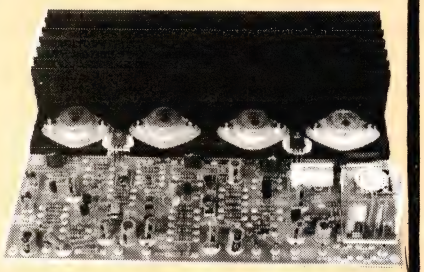


S0343 $299.00

S0342 $228.00



300 WATT MOSFET AUDIO POWER AMPLIFIER

cent developments in high fidelity sound reproduction items have occurred which place stringent demands on power amplifier. Discriminating listeners have cerned subtle differences between solid state and cuum equipment and most of them seem to prefer the cuum tube sound. Moreover, the demand for ever higher tput power has increased steadily.

ere is now available the power MOSFET transistor which n provide extremely high output power together with the tues of vacuum tube sound. However, in order to attain e high performance of which these devices are capable quires careful circuit design.

ne acoustic fidelity laboratory design engineers have onducted extensive design and test activity in order to roduce a superb product for the do it yourself audio nthusiast. With a reasonable amount of care taken in its onstruction, an amplifier rivalling the top of the line quipment may be realised at an extremely modest cost.

Specifications:

Power Output: 300W into 4 Ohms (0.1% THD)
200W into 8 Ohms (0.02% THD)
Frequency Response: 10 Hz - 20 KHz
Total Harmonic Distortion Less than 0.03%
Input Sensitivity and impedance at 1 KHz, 1V 47 K Ohms
Load Impedance: 4 - 16 Ohms
Power Requirements: ±55 to ±65V DC 8 A (Each Channel)
Dimensions: 287 x 205 x 60 mm
Weights: 4.62 lbs (2.1 kg)
Recommended Transformer: 45V + 45V, 500VA (T0265)

A TOTAL MIRROR-IMAGED, FULLY COMPLEMENTARY, 250W RMS, MOSFET AUDIO POWER AMPLIFIER

Power Outputs: 120 Watts (RMS) into 4 Ohms, 80 Watts (RMS) into 8 Ohms, When 33V + 33V AC, 220W power transformer is used.
250 Watts (RMS) into 4 Ohms, 150 Watts (RMS) into 8 Ohms, When 42V + 42V AC, 500W power transformer is used.

Frequency Response: 3Hz – 22,000Hz (±0.8dB)

Total Harmonic Distortion: Less than 0.03%

Input Sensitivity: 1 Volt input for full rated-output, at 1kHz, into 47K Ohms.

Load Impedance: 4-16 Ohms.

Power Requirements: 33V + 33V AC, 220W (Each channel) or 42V + 42V, AC, 500W (Each channel) or ±46VDC, 4A, ±60V DC 6A (Each channel) (the a/m DC Voltages were measured at empty load)

Dimensions: 205 (W) x 60 (H) x 165 (D) mm

Weights: 2.64lbs (1.2kg)

Recommended Transformers:
30V + 30V, 225VA (T0242)
or 40V + 40V, 500 VA (T0264)

+/- 0-50V 6A REGULATED PSU S0010 +$159.95

+/- 50V/6A DC Power Supply

5A RMS Regulated output per Rail

O/P Per Rail

Output voltage: +-0-50V DC (+-0-35V 5A RMS Regulated)

Current: 2A, +2A=4A, +2+2=6A

Overload Indicator: Current Limit
Sharp cut out

Output reset turn the selector to current limit point.

I/P Transformer: 30-35Vx2 15A 500VA

Recommended: 30+30V/500VA (TO262)

STEP-DOWN TRANSFORMERS 240V TO 110V AC

Many people come back from an overseas trip with audio, video or computer equipment which will only run at 110V. They get caught. But all is not lost and some of this equipment will run quite happily via a 110V isolation transformer. Pictured is one of a range of 110V isolation transformers manufactured by Harbuch Electronics. All are based on the company's toroidal transformers and thus they are compact and have a low residual hum field. Units are available with ratings of 60VA, 120VA, 300VA, 500VA and 625VA. The units up to 300VA are all housed in the same size case, measuring 125 x 75 x 185mm.

Cat. No.	Rating	Price
T0301	60VA	$125.50
T0302	120VA	$128.50
T0303	160VA	$138.50
T0304	300VA	$149.50
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CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

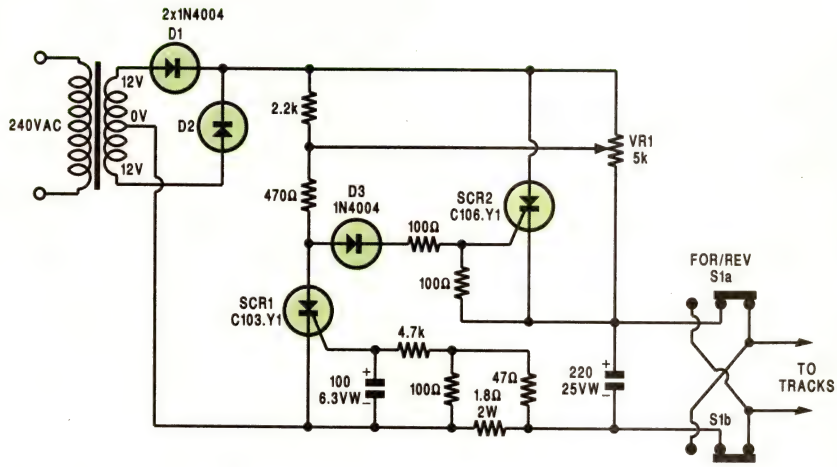
Low-cost controller for model trains

Here is yet another train controller circuit. What's so special about this one? Well, it provides smooth control to give a realistic effect and the parts are cheap and readily available.

The speed of the train is governed by the amount of current fed to it through SCR2. This in turn depends on SCR2's gate current, as determined by 5kΩ slider pot VR1.

Built into the circuit is an automatic trip which shuts down the current supply to the locomotive in the event of more current being demanded than is reasonable (eg, if there is a short circuit across the rails). This feature is based on the 1.8Ω "trip" resistor at the bottom of the circuit. It works as follows.

When the voltage developed across the trip resistor reaches a predetermined value, SCR1 turns on and deprives SCR2 of its gate current during successive positive mains half cycles. As a result, SCR2 turns off and cuts the supply to the locomotive. This removes the current via the 1.8Ω sensing resistor and thus SCR1 turns off and allows SCR2 to turn on again. Hence, if the short circuit or overload is maintained, the circuit will oscillate between the on and off conditions. If you want to operate two trains at the same time, simply switch a second 1.8Ω resistor in parallel with the existing resistor.



Switch S1 reverses the polarity of the supply to the track, to provide reversing. To prevent derailments, this switch should be operated only after the locomotive has been brought to a complete standstill. Incidentally, watch out for the base configuration of the C103Y1 (SCR1), as some of them apparently left the factory with their cathode and anode leads transposed – you have been warned!

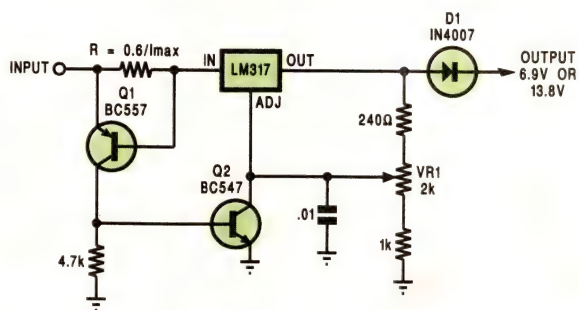
Finally, don't forget to put a dab of CRC contact cleaner on the electrical connections of your train (wheels, motor armature, etc), as no amount of electronic wizardry will make a "jerky" train run smoothly if the contacts are dirty.

B. McTighe,
Minto, NSW. ($25)

6/12V gel cell charger

This circuit will charge a 6V or 12V gel battery at constant voltage from a DC plugpack supply. It's based on an LM317 variable voltage regulator which has an inbuilt current limit of over 1A. Because few plugpacks can supply this current without cooking, a current limiting circuit based on Q1, Q2, R1 and R2 has been added.

R1 sets the maximum current according to the formula R1 = V_{BE}/Imax; eg, for a 500mA plugpack, R1 = 0.6/0.5 = 1.2Ω. If the load attempts to draw more than Imax, Q1 turns on and thus Q2 also turns on and pulls the ADJ pin of the LM317 towards ground potential. This reduces the output voltage from the LM317 until the load draws no more than Imax. D1 prevents the battery from discharging through the charger when turned off.



To adjust the unit, connect a 100Ω 5W resistor between the output and ground, switch on and set VR1 to give the desired output voltage (either 13.8V or 6.9V).

E. Kochnieff,
Lutwyche, Qld. ($15)

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require a
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nultiple flashes. It has an extremely
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t a fraction of the price of a com-
ercial unit.

The light is picked up by a BPW21
icon photocell. Resistor R1 is cho-
n so that, in ambient light condi-
ons, it does not develop across it the
2V necessary to charge the 0.47µF
olyester capacitor via the base-col-
ctor junction of transistors Q1 and
2. Q1 and Q2 are used as diodes
ith extremely low leakage – their
mitters are not connected.

When the flash is triggered, the volt-
ge across R1 exceeds 1.2V and most
f the current through the BPW21
harges the 0.47µF capacitor via Q1 and Q2. This capacitor is charged in proportion to the flash duration and intensity, and the resulting voltage across it applied to the gate of FET Q3.

Q3 in turn drives a 100µA meter movement via a 9.1kΩ resistor. Because the gate of the FET represents a high impedance, the meter reading will be unchanged over several hours. The meter is reset by discharging the 0.47µF capacitor via a 1kΩ resistor and S1b (ie, by switching the unit off).

This means that the unit must be switched off and then on again before each new reading, unless a cumulative reading is required. VR1 and the 1.5V battery are used to zero the meter before a reading is taken (ie, when the 0.47µF capacitor is discharged).

The meter covers the range from f/2 to f/16 at 100 ASA film speed over two ranges. To calibrate the unit, first adjust VR2 so that the meter reads f/11 at centre scale on the high range, using a flash on manual set to give f/11 at the distance to the photocell. By changing the distance between the flash and the photocell, the rest of the meter can be calibrated.

Finally, the BPW21 photocell was obtained from RS Components (stock no. 303-719), phone (02) 669 3666. The same part is also listed in the Farnell catalog (order code BPW21R), phone (02) 645 8888.

V. Erdstein, Highett, Vic. ($20)

Power supply pre-regulator circuit

This power supply pre-regulator circuit is designed to reduce the power dissipation in the main regulator. It does this by automatically switching between a 2-diode centre-tap full wave rectifier for low output voltages and a 4-diode bridge arrangement for higher output voltages.

If V_{OUT} is kept below 48V, pin 3 of IC3 is below pin 2 and thus pin 6 is low and optocouplers IC1 and IC2 are off. This effectively produces a centre-tapped full-wave rectifier circuit, with current passing only through D1, D2 and D3.

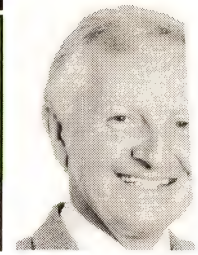
If, on the other hand, V_{OUT} is increased to greater than 48V, pin 6 of IC3 goes high and IC1 and IC2 fire SCR1 and SCR2 via diodes D4 and D5. This now effectively produces a 4-diode bridge rectifier, thereby doubling the input to the main regulator circuit.

IC1 and IC2 minimise the surge current into the 1000µF capacitor by firing SCR1 and SCR2 at the zero crossing point, while D4 and D5 prevent reverse polarity voltages from appearing across their gate-cathode junctions. Note that the pre-regulator reverts to a 2-diode full-wave configuration if a short circuit occurs across the output when running V_{OUT} above 48V, thus reducing the dissipation.

G. Freeman, Nairne, SA. ($20)

REMOTE CONTROL

BY BOB YOUNG



How to prevent damage to R/C transmitters & receivers

This month, we will look at some of the problems associated with maintaining the modern R/C receiver &, in particular, how to minimise damage when a crash occurs. Also, there is some very practical advice on how to avoid serious damage to the transmitter.

Before moving on to receivers with their problems of high "G" forces together with dust and water ingress, I feel I should round off the transmitter articles with a bit of friendly advice. I said transmitters usually have a long and placid life but I should qualify that. I am reminded of a few incidents concerning transmitters, from my servicing experience.

I once had a very irate customer in Melbourne return a valve transmitter (tuned reed) that I had just serviced and it was not working well at all. I can assure you, that on this occasion the set was working perfectly when it left our service department (I can hear mutterings about that's what they all say) and when I opened the package, even I could tell that the transmitter was not at all well.

For one thing, when it left us the transmitter was 100mm thick and now it was just 25mm thick. What's more, the valve was on the inside of the case when it left us and now the tip of the valve was sticking out of the front of the case. Add to this the fact that all of the control levers and switches were laying flat on the front of the case instead of sticking up in the air as is normal and I just knew that something was not normal.

My first thought was in keeping with the serviceman's mentality that the customer had been fiddling again and trying me on. As it turned out, the package had fallen off the trolley at the airport and had been run over by a truck. I apologised mentally to my customer.

Another threat to the well-being of the transmitter, in this instance the plastic case of a transmitter, is leaving it in direct sunlight in a car; particularly if they are left on the back shelf. The temperatures in a locked car summer are quite high and I ha seen a few melted transmitter case

Lost transmitters are not uncor mon, being put down somewhere ar forgotten. Stolen transmitters rai their ugly heads on the odd occasio although rarely on a flying field. must say that I have never heard stealing on a model field and there i valuable stuff lying about all over th place. Garage thefts seem to be th most common. One very commo threat to transmitters is being left o the roof of a car and falling off durin the trip home.

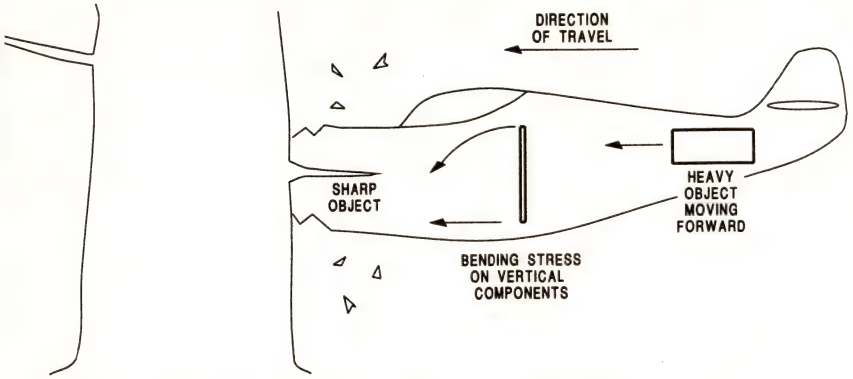
Lost transmitters are not uncommon & they are also stolen occasionally. Another common threat to transmitters is being left on the roof of a car & falling off during the trip home.

Irate wives

By far the greatest threat to the well-being of transmitters however is irate wives and girl friends. Do not laugh, for there is nothing more vengeful than a woman scorned. Male modellers can get very carried away with their second love and wives, waiting hopefully in bed until two or three in the morning before falling asleep, tend to be a bit dirty in the morning.

Now the most obvious object for revenge is the transmitter. The scorned woman sees her lover fondling this object of passion and often exacts a terrible reprisal. Beatings with a hammer are not uncommon. Trips out of a second floor (bedroom?) window are not unknown. Immersion in a hot, soapy bath has been encountered. So rounding up on the care and protection of the transmitter, if you are male and must indulge in foolish, insensitive and very dangerous behaviour, lock your transmitter away in a safe place.

In case you think I am joking about



.1: during a crash, sharp objects at the front of the aircraft can piece nerable components such as receiver PC boards & fuel tanks, while heavy ects towards the rear fly forwards to cause further damage.

e foregoing, my own wife, on one casion, exhibited such a reaction er a particularly insensitive period frantic model building. This was ıite early in our marriage and I came one morning after a long building ssion to find my wife asleep in the ɔare room and one of my model fuse- ges tucked into bed in her place. I ɔt the message.

However, let's get back to receivers. he modern receiver is a very reliable nd robust unit. It has to be if it is to urvive what modern modellers sub- ect it to. With some model aircraft ıow capable of 200+ km/h, a crash an be devastating, with "G" forces neasured in the 100s.

Statistically, the most usual cause of failure in a receiver is crash damage. Even here, it is usually something sharp piercing the receiver case which causes the actual damage. Thus there is much that can be done to help the receiver survive even a high speed impact.

Avoid crashes

Rule one is to avoid crashes like the plague. This sounds like a ridiculous statement but you would be surprised how many flyers deliberately ignore this rule, largely out of impatience, but often out of a complete lack of understanding of the concept of preventative care.

Therefore let us examine each aspect in turn. Firstly, why is it important to avoid crashes? Quite apart from the obvious cost involved in a crashed model, and this can run into many hundreds or even thousands of dollars, there are other factors involved, some technical, some psychological.

To begin, learning to fly a model aircraft is a difficult and time consuming process. The ultimate success depends upon a large range of factors, which include aptitude, attitude, eyesight and hearing. However, for most people the key factor is six consecutive weekends (or flying sessions).

This is the prime reason for beginners to avoid crashing, as a crash will break the consecutive training sessions whilst repairs are in progress. During this time, what has been learned will be forgotten and the process of learning in this way can stretch out to several years (assuming that the modeller hasn't given up in disgust). So keep that impatience in check and if you are learning, always have a spare model so that continuity can be maintained.

For those who have already learned to fly, the break whilst repairing the model is not so serious, except psychologically. The important point is that during a crash, components can be stressed to close to the point of failure. This is particularly true of components such as crystals and IF coils which are not restrained inside their cans.

Here we move to point two, the reason for the rule. Even a thorough check by a competent serviceman may miss these stressed components. Engine vibration and high "G" manoeuvres can then cause these stressed components to let go in flight, resulting in another crash and even more stressed components. This spiral of crash, stressed components, and crash again is devastating to model builders and is the prime cause of many leaving the hobby. So when I see a flyer adopt a "she'll be right" attitude and launch an obviously sick model, I am horrified, for in my mind's eye I see a chain of events which may ultimately

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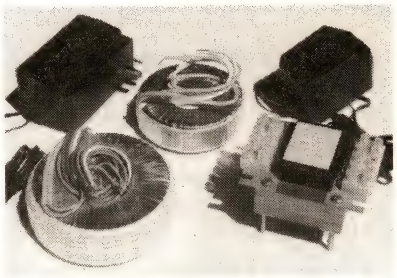
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DICK SMITH ELECTRONICS
APOLOGY
We apologise that in the October issue of Silicon Chip the Yaesu FRG 100 receiver was incorrectly priced at $999.
The correct price is $1199, an increase forced upon us by exchange rate fluctuations.
We apologise for any inconvenience to customers.

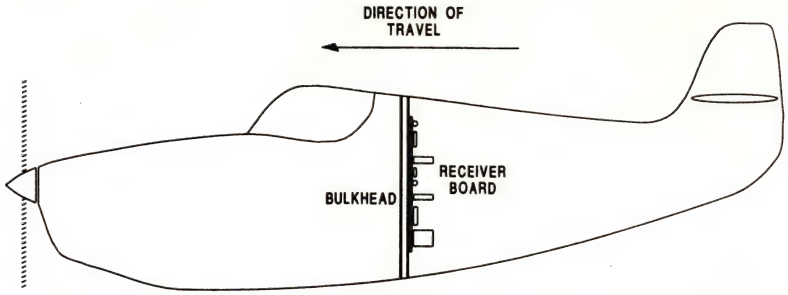

Fig.2: crash damage to the receiver can be minimised by mounting it against a bulkhead with the PC board at right angles to the direction of flight. The components should be on the side facing away from the direction of travel

cause that modeller to leave the hobby.

Now we move on to the all-important aspects: prevention of the crash and prevention of damage in those crashes that cannot be prevented.

In this section, most of the emphasis will be on aircraft, for these are the most difficult models in which to apply preventative measures.

Preventative maintenance

The success of all aspects of aviation has grown largely out of the concept of preventative maintenance and crash investigation. You cannot stop and pull an aeroplane over to the side of the sky. Thus, you must work to see that all possible avenues for error are eliminated. You must work to ensure that the pilot is able to get the thing safely on the ground if something does go wrong and finally investigate the crashes that do occur to find out what went wrong and close the loop in further preventative measures.

The successful model flyer adopts exactly the same routine. It is no accident that some modellers are forever crashing, while some fly the same old model year after year. Without labouring the point then, prevention begins in the building process. Great care should be taken to ensure that the airframe is sound in construction and true in alignment. The choice of aircraft should be appropriate, so avoid the 4-engine super scale bomber or the 200km/h pylon racer as your first model.

By far the most important and effective aspect of prevention is in the installation of the radio gear. The main point to keep in mind is what sort of forces are involved in a crash. Fig.1 shows some aspects of these forces. Note that the there are three major components of destruction to keep in mind. These are as follows:

(1) Sharp objects in the front of the model. Due to inertia, all components will continue to move forward and thus will meet with considerable force any sharp object situated in the front. Things such as engine mounting beams and long bolts on nosewheel brackets are particularly destructive. They can pierce fuel tanks, battery packs and receivers and cause irreparable damage.

"Engine mounting beams & long bolts on nosewheel brackets are particularly destructive. They can pierce fuel tanks, battery packs & receivers & cause irreparable damage".

(2) Heavy components behind fragile components. At times, it is useful to mount the battery pack at the rear as a means of balancing the model. But remember that this will fly through the fuselage like a bullet in a crash. Any receiver or servos in its path are going to be subject to a hammering when they meet this panjandrum.

(3) Bending stresses. Components standing at right angles to the line of flight will be subject to bending stresses and thus fracture or snap off completely in a crash. Receivers are very prone to this sort of problem.

Minimising the damage

Now let us examine ways to minimise this damage. Engine bearers these days are a little passe, as the r mount has largely superseded t They are still used by some mode to spread the engine weight an bration back into the fuselage. A g solid beam mount is still one of most effective ways of dissipating gine vibration.

If you do use beams, make s there is a 2.5mm plywood bulkh butted against the beam ends. Cut all the nosewheel mounting bolts fl with the nuts. Finally, check for a other protruding and sharp objects front of the receiver and servos. Lig weight covers are often sufficient deflect flying receivers.

There is little that can be done ab heavy objects behind fragile ones. T best fix is to try to avoid this situatio ensure they are mounted firmly a perhaps provide a deflection pla between them. Again a plywood bul head suffices here.

Nor can much be done to prote the servos but you can protect t receiver. Firstly, ensure that the r ceiver is mounted with the PC boar at right angles to the direction of fligh and the components are on the sid facing away from the direction of trave – see Fig.2.

Receiver protection

A fair amount of protection can b provided for the receiver using a mod ern packaging foam. To do this, construct a self-contained housing which completely surrounds the receiver. Small, individual sheets of foam pushed down around the receiver are not going to help when the fuselage explodes on impact, sending the receiver flying through the air. On the other hand, a thick housing will stay with the receiver and allow it to bounce along the ground without damage (hopefully). This housing can be glued or wrapped in tape; the important point is that it stays intact on impact.

Make sure that the receiver is mounted against a flat bulkhead with no protrusions and that the foam is not jammed in too tight; tightly packed foam will transmit engine vibration to the receiver components. Some compromise may be required here on the thickness of the foam. You may never have a crash (think positive), but you will certainly have engine vibration for the entire life of the model.

Next month, we'll cover the technical aspects of receiver servicing. **SC**

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JAYCAR DEALS FOR NOVEMBER

VIDEO AND CAMCORDER ACCESSORIES

VIDEO PROCESSOR WITH ENHANCER & STEREO MIXER

This mixer will allow you to make quality home videos from your camcorder. You can add a stereo input from your stereo / CD etc, and mix it with the sound originally recorded as well as a narrative with a microphone. All this can be mixed together and recorded on your normal VCR. There is a built in video enhancer to ensure no loss of picture quality occurs as you transfer from the camcorder (VHS-C/Video-8) to your VHS home VCR.All line inputs are RCA, microphone is 3.5mm. Power supply required is 12VDC - 100mA, use MP-3006 - $15.95 and microphone use our AM-4090 - $15.95.

NEW

Size: 220(W) x 125(D) x 65(H)mm. Cat #: AV-6410 **$79.95**

VIDEO CAMERA BATTERY

This battery is a universal type that fits Sony, Panasonic, JVC, Hitachi and Canon camcorders. It is 6v, 2000mAh and it uses quality Japanese cells.

NEW

Size: 90(H) x 45(W) x 43(D)mm. Cat #:SB-2320.

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BATTERY ELIMINATOR

Suits Sony, Panasonic, JVC, Canon & Hitachi. This unit allows you to power your video camcorder from the cigarette lighter. This saves batteries. It has a curly cord lead about 2 metres long and reduces and regulates the voltage to 6 volts. An economical way to save your camcorders batteries.

NEW

Cat #:MP-3130. **$29.95**

TRIPOD - Large

Features: •two way pan head with quick-release plate and spring operated locking pin for camcorders •extra long stick •continuously adjustable by means of a crank with adjustable friction brake •tripod legs with vertical lever locks •cross bracing and closed channels - rubber feet •max extended height 131cm •retracted height 53cm

Cat #: AV-6535. **$59.95** Tripod shown fully retracted

TRIPOD - Small

Table tripod. Ideal for use with our video transfer system. Extremely small when folded - about 180mm long. Height when opened 120mm. Very stable.

NEW

Cat #: AV-6532. **$18.95**

DIRECTORS BOARD

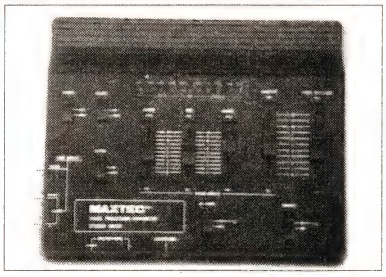
You see these used all the time in commercial movie making. It allows you to number each take, if you take more than one and also allows the camera operator to correctly focus on the board. It's even supplied with a piece of chalk on a string. Size: 280 x 255mm.

Cat. #: AV-6530

$16.95

NEW

PROFESSIONAL VIDEO PROCESSOR WITH ENHANCER / MIXER



If you require more features than our basic video processor , this may do the job. Extra features include: •two inputs for video - one camcorder and one VCR or two camcorders etc. •two switchable stereo sound inputs, one can be for CD, the other tape •twin LED VU meters •bypass switch •AV fade switch - fades in or out both audio and video simultaneously •headphone socket •stereo microphone input sockets. All inputs and outputs are RCA, microphones are 6.5mm, headphone is 3.5mm. Power supply required is 12VDC 800mA - use Cat MP-3015 $24.95

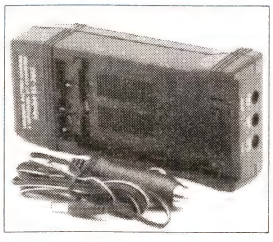
NEW

Specifications

Audio Input Sensitivity		Audio Freq Resp	20-20kHz
CD/Tape/VCR/Cam Audio	100mV	Video Output Level	1V P-P/75Ω
Microphone	1mV	Video Enhancer Range	+/- 6dB
Max Audio Output	2v	A/V Fade Time	3-5 seconds
Audio Distortion	1.5%	Power Source Required	12VDC 800mA

Cat. # AV-6415 **$139.50**

UNIVERSAL VIDEO BATTERY CAR CHARGER / DISCHARGER / POWER SUPPLY



•This universal charger will: - •Accept most camcorder batteries. These include Sony 8mm NP-22, NP-55, NP-66, NP-77 6 volt, Panasonic / JVC VHS-C 6 volt, Canon 8mm 6 volt, Olympus, Nikon, Elmo, Chinon 8mm 7.2 volt, RCA / Hitachi 8mm 6 volt and all 9.6 volt VHS and VHS-C batteries. •Discharge and charge all of the above from your car cigarette lighter or 12 volt DC source - even a 240 volt plugpack 12VDC 1000mA (use slow charge mode only) Cat MP-3015 $24.95. •Two charging times available - emergency QUICK charge in 20 minutes or NORMAL charge about 1-2 hours. •Power your 6, 7.2 or 9.6 volt camcorder from your cars power through this supply. IE: it will reduce the cars 13.8volt down. Supplied with car cigarette lighter power lead and instructions.

NEW

Cat. #: MB-3520 **$59.50**

CAMCORDER WIRELESS MICROPHONE SYSTEM

With this microphone system you can be videoing someone 50 metres away and hear and record them talking as if they were standing right next to you. And it works well. It consists of • a receiver which mounts on the camcorder camera shoe and plugs into the microphone input. It is about the size of a packet of 20 cigarettes (88 x 60 25mm approx) •An earpiece is supplied so you can monitor what is being said •A transmitter which clips on the belt of the person using the microphone. The microphone is then plugged into the transmitter (which is the same size as the receiver) •Two microphones are supplied - one is a tie clasp type and the other is a small hand held type. Other features include: •two operating frequencies •up to 200 feet (66 metres) line of sight range •extremely lightweight and compact •eliminates wires from the microphone •earphone allows "live" monitoring

NEW

Both transmitter & receiver require a 9 volt 216 type battery Cat. #: AM-4065 **$129.50**

RECHARGEABLE BATTERY CARRY CASE

This case will accept a 6.5Ah gel battery. It is ideal for video camera users or for hand held 12 volt spotlights for shooters, night bush walks etc. It has leads for connecting to the battery inside the case (positive lead is fuse protected) and a cigarette lighter socket is mounted on the side. It has removable strap for hanging on the shoulder and a belt loop.

NEW

Cat #: HB-5950 **$24.95**

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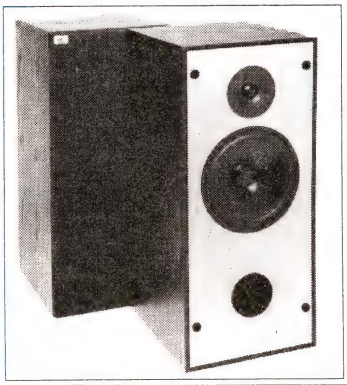
Kit. #: SA130 **Normally $999 Nov Only $899.00**

All prices are for complete kits - speakers, crossovers and cabinets. Discount only applies to full kits. See catalogue for full details.

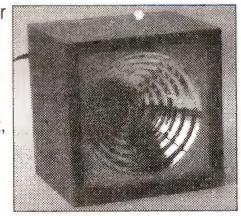


Professional High Power Disco Strobe

This is the type of strobe that you see when you go to the disco, or when you hire a mobile disco for a party. The light output is dazzling. Features include:- • on/off switch on rear • steel box with strong handle for mounting • high power German made twisted Xenon tube • removable perspex tube guard for cleaning • coloured filter mounts inside of perspex for different effects • strobe tube is unplugable • 240V. Size 225(W) x 190(H) x 170(D)mm Mobile disco operators, contact our Wholesale Dept. for pricing on purchases of 5 pieces or more.

Cat. YS-3010 **$179.50**

DISCO STROBE

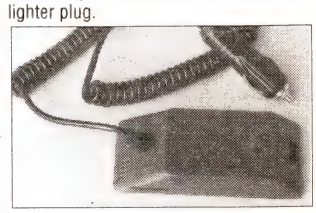


Add some life to your next party! A strobe creates that slow motion, silent movie effect. This strobe operates off 240 volt, and has a speed adjustment control. It's housed in a square wooden box. Add to this one of our new "black light" globes or fluorescent tubes for great party effects. Don't pay over $100 for a kit. Includes quality German Xenon tube.Size 148(W) x 148(H) x 118(D)mm.

Cat. YS-3000 **$59.95**

Cellular Phone Battery Eliminators

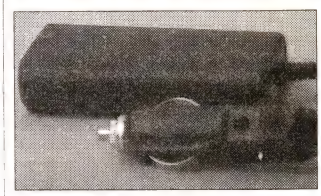
When you are in your car, use your cars' power and save your telephone batteries. Simply slide the battery pack out of the phone, and replace it with the Eliminator. It has a curly cord attached with a cigarette lighter plug.



Motorola Micro TAC PT500 Flip Battery Eliminator

Cat. #: MP-3110

Was $39.95



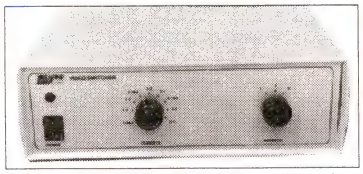
Novatel PTR-800 Series Battery Eliminator

Cat MP-3112

Was $39.95. Both Now Only $20 each

VIDEO SWITCHER KIT

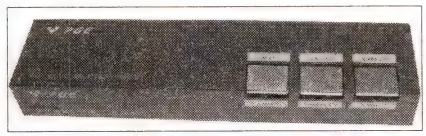
Ref: Silicon Chip June 1992



Do you have two or three VCR's and need to watch and dub tapes between them, or need to copy old Beta tapes to VHS, or from your camcorder to your VCR? You can replace the inconvenience of swapping cables with this video switcher kit. The kit is straight forward to build, and will leave you with a professional switcher and monitoring unit. All inputs and outputs use RCA connectors. The kit includes box, front and back Scotchcal labels, video modulator and all specified components. Options are 12V AC 500mA plugpack. Cat. KC-5116

Cat Price $129.95
Now $69.95 Save $60

NEW

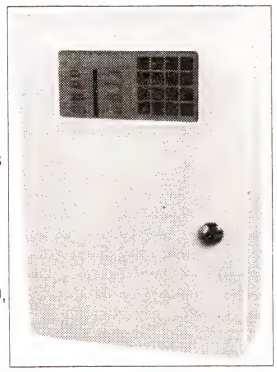


VIDEO SWITCH BOX

If your TV has not got enough inputs, then this switch will solve your problems.
Most TVs have only one set of inputs. It becomes difficult when you purchase a second VCR, or a TV game or a Laserdisc, etc. How do you connect two or more components into the one socket?
This switch will solve that problem. It has 3 inputs and one output to the TV.
All connections are via RCA plugs and each input has 3, one for video, and two for audio (L & R).
Once wired, all components can be left wired in permanently. The switch box requires no power. Lead for connection from the video switch box and TV is supplied (3 x RCA to 3 x RCA).
Size 193(L) x 46(D) x 28(H)mm

Cat. AC-1662 **Was $49.95 Now $39.95 Save $10**

BELLMATE 1000 ALARM PANEL SPECIAL



We're overstocked. For one month we have taken $30 off the fabulous eight sector Bellmate Alarm Panel.
Features include: •8 programmable zones plus tamper and panic •silent alarm if desired •4 tamper systems •split zone inputs •1 or 2 triggered inputs •handover zone programmable •remote available. See catalogue for full specifications. Requires backup battery - 1.2Ah Cat. # SB-2480 $28.50, 6.5Ah Cat.# SB-2486 $43.50. 240VAC power supply Cat. # MP-3021 $24.50.
Cat. #: LA-5324

Normally $229 Nov $199 Save $30

INSTALLERS Contact us for great prices

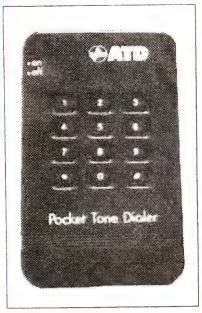
BELLMATE 100 - PULSE COUNT PASSIVE INFRA RED

Specifications:

- 24 element zones in 3 layers
- Wide angle 90° coverage
- Coverage 15 x 15 metres
- Operating voltage 9 - 16V DC
- Relay output - N.C. contacts
- Tamper proof - 22Ω resistor with short circuit protection
- Max rating 1A resistive/24V DC
- Size 110(H) x 70(W) x 55(D)mm
- Current draw 20mA
- Tamper switch for 24 hour zone
- Pulse count switchable, normal or 3 pulse
- Sensitivity adjustment
- Sliding PC board
- N.C. terminals
- 2 year warranty

Cat. LA-5016

$49.95



TELEPHONE TONE DIALLER BARGAIN

GENERATES DTMF SIGNALS

For use in conjunction with telephone answering machines, remote banking, computers, electronic voice mail and call diverters. Was selling for $19.95. Now an amazing half price. This product is not Austel approved.

Cat: YT-6155 **Only $9.95 Half Price**

BELLMATE 200-PASSIVE INFRA RED

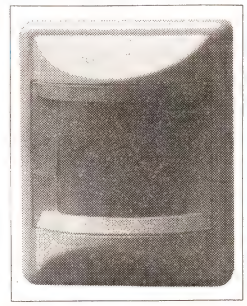
The baby of the Bellmate PIR range. The 200 breaks another price barrier. It is the first time we have been able to offer a quality PIR with 12 months warranty for under $35. Amazing!!!

FEATURES AND SPECIFICATIONS

- Dual element pyroelectric sensor
- 24 dual element zones in 3 layers
- Wide angle 90° multi layer coverage
- 12 metre range
- Operation voltage 9 - 16V DC
- Current draw 20mA
- Tamper proof
- LED indication
- Relay output. N.C.22Ω for shorting protection
- Max rating 0.5A 24V DC resistive
- Colour white
- Size 93 x 73 x 43mm
- Hall lens Cat. LA-5014 $4.95

WARRANTY 1 YEAR

Cat. LA-5017 **$34.95**



JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS

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NEW KIT NEW KIT NEW KIT

18/36 WATT HIGH EFFICIENCY FLUORO LIGHT INVERTER KIT

REF: Silicon Chip November 1993

NEW

This highly efficient fluorescent inverter will power either 18 or 20 watt tubes or 36 and 40 watt tubes from a 12V battery. It is designed to be housed in a standard 18w or 36w batten fitting so that the inverter and lamp are an integral unit. Features include: •fast starting without flicker •preheated filaments •constant brightness from 11-14.4V supply •reverse polarity fuse protection •light output equal to conventional mains powered lamp. It is ideal for camping, emergencies or part of a solar cell powered lighting installation for remote areas. The Jaycar kit includes PCB's, transformer components, heavy duty battery clips plus all specified elec. components.

Cat. # KC-5143 **$79.95**

THE LATEST KITS FROM JAYCAR

PC Controlled Eprom Programmer	KA-1752	$99.50
Decoder For ACS Signals	KA-1753	$18.95
Noise And Distortion Meter	KA-1751	$139.50
1GHz Frequency Counter	KA-1750	$149.50
50mHz Frequency Counter	KA-1749	$89.50
DSO Adaptor For PC's	KA-1748	$85.00
Courtesy Light Timer	KA-5138	$14.95
5v to 12v Convertor	KC-5137	$24.95
In Circuit Transistor Checker	KC-5136	$14.95
Colour Video Fader	KC-5135	$29.95
Digital Voltmeter	KC-5134	$32.95
Woofer Stopper	KC-5133	$49.50
Nicad Cell Discharger	KC-5132	$27.95
LED Audio Power Meter	KC-5131	$24.95
Alarm Triggered Camera	KC-5130	$49.95
Camcorder Mixer	KC-5129	$29.95
Low Fuel Indicator	KC-5128	$11.95

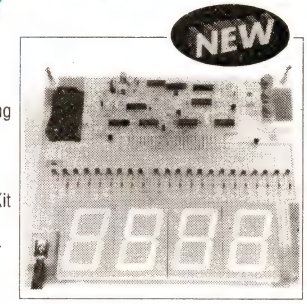
NEW KIT NEW KIT NEW KIT NEW KIT

JUMBO DIGITAL CLOCK KIT

REF: Silicon Chip November 1993

If you need a clock with a very large digital display, this maybe it. It features seven segment LED displays that are 70mm high, has battery backup, automatic display dimming at night, AM/PM indication and a 12 hour display. It is designed to hang on a wall and can easily be read at distances of 40 metres or more. It's just the shot for a factory or small business, gymnasium, squash court etc. Kit includes PCB, LED displays, red perspex cover & all specified components. 12VDC 500mA plug pack required - use MP-3012.

Cat. #: KC-5139 **$109.00**



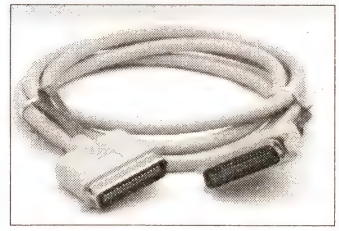
SCOPE LCD REMOTE KEYPAD

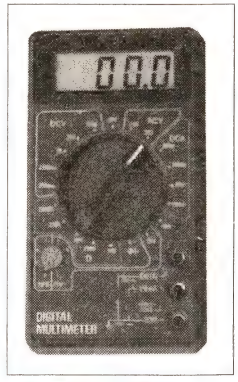
We have a small quantity left of the keypads that suit the Scope 12 sector alarm panel.

Cat. #: LA-5188

Normally $49.95

These Few $20 each





LOW COST DMM REDUCED EVEN FURTHER

Features: •3.5 digit 12.5mm LCD display •Transistor test •Diode test •10 amp current •Plug in leads. Full feature meter with plug in 4mm probes and transistor tester for under $30!!! This is the ideal first multimeter, and will give years of faithful service.

Cat. #: QM-1500

Only $29.95

COMPUTER LEAD BARGAIN

NEW

36 way CENTRONICS plug to 36 way CENTRONICS plug with earth. Length-2 metres. Don't pay $26.95

Cat. #: PL-0878 **Only $14.95**

8 PIECES OF PLASTIC SPEAKER CORNERS

At last, an economical way to buy plastic speaker box corners. They are heavy duty plastic moulded featuring male / female inserts. They are the same as our Cat # HM-3828 which sell singly for $2.95 each. We now have 8 pieces in a bag for only $17.95 saving you $5.65.

Cat. HM-3829

PACK OF 8 NOW $17.95

NEW

Bargain Priced ATD Answering Machine

The ATD 1800 is a very popular answering machine.All the big stores and discounters sell it for $99. Because so many are sold ATD get a quantity back from retailers which have been declared faulty. These are checked by ATD, and many are found to be OK. The faulty ones are fixed. They can't be sold as new because they may have a scratch on them, or marks where the power lead has wrapped around the unit. All units are supplied with instruction manuals, phone lead and power plugpack. They have a THREE MONTH REPLACEMENT WARRANTY. Save 40% off the new price.

Cat. YT-7028 **Only $49.95 - You won't buy cheaper**

BECOME A JAYCAR DEALER

Contact our Wholesale Dept. on (02) 743-5222

BUY IN BULK AND SAVE

AA NICAD BATTERY STACKER

NEW

This plastic stacker helps to hold AA nicad batteries together. For example, if you need to put 4 together, 2 can be put on each side of the stacker, tape or heatshrink them together and you have a battery pack. Saves using solder tags on nicads. Great idea!!! Measures 102 long x 14 x 10mm.

Cat. #: PH-9225

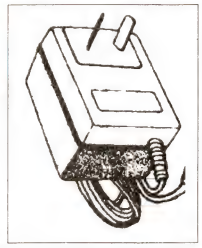
$1.50 each

6 VOLT NICAD / LEAD ACID BATTERY CHARGER

NEW

These are rare! This one is a quality ARLEC brand and delivers 150mA at 5.8V. Perfect for charging 6 V nicads & lead acid batteries. Delivers 150mA so will fully charge a 5A dolphin type battery in about 30 hours. Lead terminates to a strange 2 pin plug, which will probably have to be removed.

Cat. # MB-3520 **$17.95**



38Ah GEL BATTERY SALE

Huge capacity, ideal for back-up supplies, camping, etc. Panasonic brand. Size 197(L) x 165(D) x 175(H)mm. Current charge 3.8A for 10-14 hours - longer time if lower current used. Discharge current 20 hour 1.9A.

Cat. SB-2495

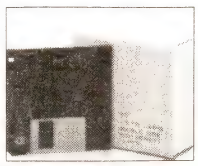
Cat Price $149.95

November $79.95

Save $70.00

LOWER PRICES ON COMPUTER DISKS

Jaycar has sold millions over the last few years. Our stand - ard white box disks have a **lifetime guarantee.** They are supplied with envelope, index labels & write protect tabs.



5.25" DSDD	XC-4730/Pkt 10	**$4.50**			
5.25" DSHD	XC-4732/Pkt 10	**$8.50**	**IBM FORMATTED**		
3.25" DSDD	XC-4736/Pkt 10	**$8.50**	5.25" DSHD	XC-4733/Pkt 10	**$9.95**
3.25" DSHD	XC-4738/Pkt 10	**$12.95**	3.25" DSHD	XC-4739/Pkt 10	**$14.95**

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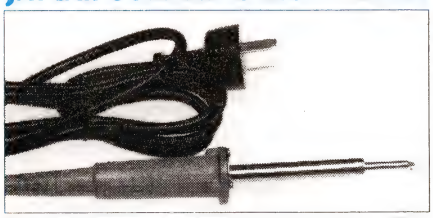
JAYCAR SOLDERING IRON - BACK IN STOCK

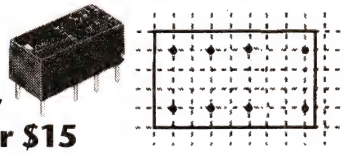


Ideal for the hobbyist and handyman. Our lowest price 240 volt quality iron has a stainless steel barrel. 25 watt. Replacement tips also available.

Cat. TS-1450
$17.95

RELAY BARGAIN
48V DIL MINI RELAY

DPDT - size 20 x 10 x 9(H)mm. Similar to our 12V version Cat. 4059 - this version is $6.95.



Cat. SY-4075
ONLY $1.00 ea or 25pcs on a rail for $15

VIDEO LEAD BARGAIN

RCA plug to TV coax plug - length 1.25 metres. Cat. AV-6590
Normally $4.85 Special Price $2.95

Greenair Negative Ion Generators

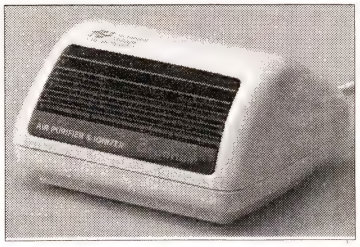
We have sold many thousands of negative ion generators over the years. These work by applying a very high negative voltage, generating a stream of negative ion electrons which are emitted into the air. These ions then attach to particles in the air such as dust which are then attracted to the ground or other solid objects (just as metal filings cling to a magnet).

Specifications: •Dimensions 105(W) x 105(D) •Weight 200g •range 14 sq mt (150 sq ft) •power consumption 240V model 3.8 watts, 12V model 2 watts.

When we first started selling negative ion generators they were $70.00

Cat. YX-2910
240V mains operated **$29.95**

Cat. YX-2912 - 12V DC model with cigarette lighter plug) **$24.95**



Hot-Sol Service Kit

This kit includes the same soldering iron as above, but comes with a range of accessories and it's all housed in its own case. Includes:

1 x Hot-Sol Butane Gas Tool
1 x Protective Cap
1 x Non-slip stand with sponge
1 x Torch Tip which gives a flame
1 x 2.4mm Soldering Tip
1 x Hot Blow Tip for shrinking heatshrink
1 x Scoop for feeding tubing to hot blow tip
1 x Hot Knife Tip
1 x Roll Solder
1 x Case which holds everything

Cat. TS-1702 **$64.95**

Optional extras

• 1mm soldering tip with catalyst Cat. TS-1704 $9.95 • 2.4mm soldering tip with catalyst Cat. TS-1705 $9.95 • Hot air tip for heatshrink Cat. TS-1708 $9.95 • Flame torch tip Cat. TS-1710 $3.95 • Small stand to suit soldering iron Cat. TS-1720 $3.95

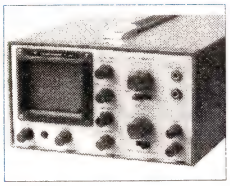
ULTRASONIC CLEANERS REDUCED

NEW

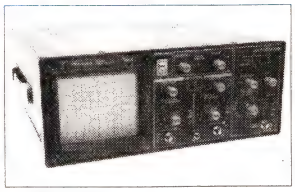
Clean your jewellry, glasses, dentures, watches, relays, switches, connectors, PCB's, pens, cameras, filters etc. It uses a transducer to produce millions of activated microscopic cleansing bubbles which blow dirt, grease and grime off surfaces and deep into cracks and holes. New model has 4 timers - 4, 8, 12 & 16 minutes. 240VAC operation. Capacity 570ml. Cat. YH-5400

Was $199.00 Now Only $159.00 Save $40

OSCILLOSCOPES FROM JAYCAR



6.4mHz
Cat. # QC-1908 **$379**



20mHz Dual Trace
Cat. # QC-1900 **$699**

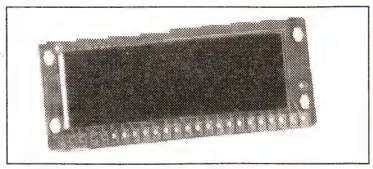
For full details and specifications see our catalogue

Probes To Suit
Cat. #: QC-1902
$39.50 ea

1/2" FOUR DIGIT LED CLOCK FREQUENCY DISPLAY

Another surplus stock purchase!!! The importer has told us that these used to wholesale at around $26.

This device is made by Liteon and its part number is 5502AIP-12S. It is designed for a viewing distance of up to 2 metres and for using in instruments, test equipment, communications, business machines, computers, microprocessors etc.



NEW

Features: •1/2" (12.7mm) red height character •flexible to select both 12/24 hours and full feature •continuous uniform segments •wide angle, long distance viewing •low power requirements •high reliability and long life

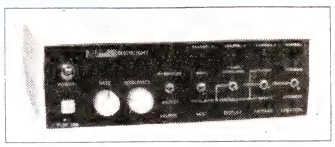
Specifications: •average forward current - 25mA •peak forward current - 200mA •com forward current - 30mA •reverse voltage - 5v •luminous intensity - type 350uCd @ 10mA •forward voltage - 2.1v @ 20mA •reverse current - 2.1v @ 20mA •size PCB 64(W) x 25(H)mm, display 52(L) x 17(H) x 5.5(D)mm •data sheet available on request

Cat. ZD-1880 **ONLY $2.95 each**

SAVE ON 20MHZ 16 CHANNEL LOGIC MONITOR

See catalogue for details.
Cat. #: QP-2230
Was $79.95 Save $20 Now $59.95

DISCO LIGHT KIT



Will drive 4 separate channels of light - 600 watts per channel. It can be driven directly from a speaker or built-in microphone. It can also produce all sorts of light patterns on its own individual chasing. For details see catalogue.
Cat. #: KC-5032
Save $10 Only $159.50

10" Forte Woofer

Low cost woofer. Square silver aluminium frame, silver dust cover, foam cone surround and black cardboard cone.

Power Handling	60 watts rms
Resonant Freq.	32Hz
Freq. range	32Hz - 3.8khz
Sensitivity	87dB 1W/1m
QMS	2.65
QES	1.16
QTS	0.80
VAS	108L
Dimensions	A277, B283, C240

Cat. CW-2120
Catalogue Price $39.95 Now $23.95 Save $16

Jaycar Butane Gas

Another Jaycar brand product. We've cut out the middleman, and reduced the price. Last year a can of 150g gas cost $7.50, now Jaycar 150g gas is only $5.95.

Use it for filling up your Hot-Sol soldering iron, other brand gas soldering irons, flame torches, cigarette lighters etc. Includes five different adaptors which cover most different nozzles. Includes filling instructions.

Cat. NA-1020 **$5.95**

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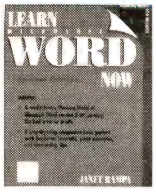
NEW BOOKS



LEARN MICROSOFT WORD NOW

NEW

A quality book with only a limited quantity available at a greatly reduced price. Be Quick!!! Includes info on installing your working model, then gives a complete guided tour of entering, editing, formatting text, saving files and printing. Includes 1 x 1.2mB 5.25" disk for IBM, PC/XT, 386. This book should sell for $65.

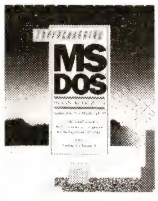
399 pages Softcover 235 x 185mm Cat. #: BM-2142 **$19.95**

THE NORTON UTILITIES

NEW

This handy reference book is a guide to recent versions of Norton Utilities. It includes •concise, easy-to-follow entries for each program with information for version 3.0 through 4.5 •a section that describes common recovery scenarios and suggests the appropriate utilities •sample menu to improve your use of MS-DOS operating system with the Batch Enhancer Utility.

92 pages Softcover 200 x 120mm Cat. #: BM-2128 **ONLY $7.95**

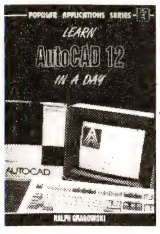


SUPERCHARGING MS/DOS 2ND EDITION

NEW

Updated for version 4.0
Another computer book which has been greatly reduced, and in limited quantities. Should sell for $65. This book has been completely updated to include DOS functions and features through version 4.0. Section 1 gives you a foundation for the advanced techniques used throughout the book. Section 2 shows you how to put it all together with useful programs, batch files and utilities you can use and create and use with DOS. Section 3 is handy quick reference.

336 pages Softcover 235 x 185mm Cat. #: BM-2144 **$12.95**



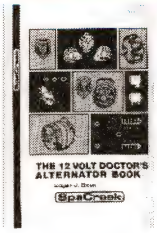
LEARN AUTOCAD 12 IN A DAY

NEW

For IBM-PC, PS2 and compatibles.
Upon completion of the projects in this book, readers are ready to apply the latest version of AutoCAD to almost any drawing task. Clearly written and illustrated step by step instructions guide readers through the use of AutoCAD to produce actual finished drawings. From setting up basic drawings to 3D creations, getting up to speed on this popular computer assisted drawing program has never been easier. Includes 5.25" disk.

154 pages Softcover 225 x 150mm Cat. #: BC-3024 **$29.95**

MORE BOOKS FROM JAYCAR

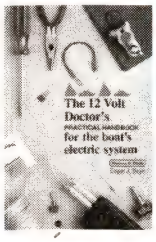


THE 12 VOLT DOCTORS ALTERNATOR BOOK

NEW

Alternators are all around us. This book firstly explains how they work, then explains about diodes, voltage regulators and batteries. It then discusses different brand alternators that are used in boats. If you are a boat owner that has a generator on board or if you just want to learn about alternators, this book will teach you. You will learn how alternators work, what they have in common and how they differ in some detail. The sketches should help to identify brands and types if not models. And the dimensions should help when you have to replace one with another. A very informative book on a subject that has very few books like this written about it.

224 pages - softcover 230 x 150mm Cat #: BB-3800 **$32.95**



THE 12 VOLT DOCTORS PRACTICAL HANDBOOK FOR THE BOATS ELECTRICAL SYSTEM

NEW

This book is a clear, useful guide for electrical system trouble shooting. It covers such subjects as electrolytic corrosion, lighting, engine instruments and alarms. This book contains all the facts you need to: •fix any problem on board - without getting help •understand basic electricity •maintain your own 12 volt system •isolate and repair elusive electrical problems •takes the mystery out of electricity. Its full of helpful drawings and diagrams to help you solve all your electrical problems.

227 pages - softcover 230 x 150mm Cat #: BB-3804 **$39.95**

THE 12V DOCTORS PROJECT BOOK

NEW

This book tells you how to make things intended for 12 volt use, and offers small helpful hints which are normally hard to find. Most ideas are boat based. Some of the projects include: •adding a third battery bank without another switch •make an ammeter for high current •high and low voltage indicator lights •various alarm systems for - bilge water, water in diesel fuel, engine, dingy etc •various switches •wind & speed indicators •motion sensors. A very informative book full of sketches and ideas.

57 pages - softcover 230 x 150mm Cat #: BB-3802 **$22.95**

POWER LEAD BARGAINS

These are black 240V 2 pin power leads as used in many appliances. We've made a bulk purchase, and can offer these at about half normal price. Length 2 metres. SAA approved. Double insulated. These normally sell for $7.95. Now only $3.95 ea. Grab one or two as a spare NOW!!!

Cat. PS-4116 National oval socket **$3.95**
Cat. PS-4117 Sanyo Rect. socket **$3.95**
Cat. PS-4118 Universal rectangular **$3.95**

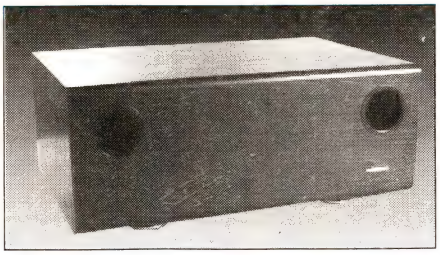
NEW

PS-4116

PS-4117

PS-4118

RE/SPONSE STEREO MINI SUBWOOFER



At last, you can now have subwoofer bass sound at an economical cost. Ideal for use with any smaller speaker system to dramatically increase the bass response.
Ideal for use with: • small bookshelf type Hi Fi speakers • rear speakers for AV surround sound • car Hi Fi systems.
The Re/Sponse subwoofer connects in line with your normal speakers, so you don't have to buy expensive subwoofer amplifiers, cabinets, crossovers, etc.
It is housed in a very smart black cabinet measuring 437(W) x 180(H) x 300(D)mm. There are two high quality drivers in each cabinet - one for each channel. The speaker impedance is 4 ohms, which is ideally suited to both car Hi Fi and Home systems. The subwoofer is connected in-line to the normal speakers via push terminals on the back of the box - in/out for each channel. Simply place the subwoofer on the floor at home, it can even be hidden behind a chair. Ideal for increasing the bass response in rear channels for surround sound systems.

Specifications

Drivers	5 1/4" high compliance	**Frequency Response**	36 - 200Hz
Max Power	100 watts	**Crossover Network**	6dB/octave roll off
RMS Power	50 watts	**Dimensions**	437(W) x 180(H) x 300(D)mm
Impedance	4 ohms	**Sensitivity**	88dB ±2dB @ 50cm

SW/AM/FM MINI RADIO

NEW

Listen to the world. Features AM/FM and shortwave band (3.1 to 17.6MHz). All packed into the smallest multiband radio we've seen. Measures only 125(W) x 70(H) x 28(D)mm.
Features include: LED band indicators, feather touch selector, micro size, telescopic FM-SW antenna, carry strap, earphone jack. Operates on 2 AA batteries. Bargain price.

Cat. AR-2200
ONLY $42.95

Cat. CS-2500

GREAT VALUE AT $179.50

Ideal for Home and Car Hi Fi

NEW

YCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS
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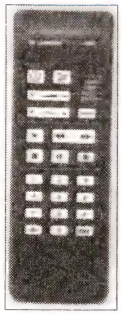
QUIK KIT COMPONENT CASE

Quik Kit is a very sturdy storage and carry case for components, small parts and tools etc. It has 11 compartments inside, there are 10 small ones measuring 59 x 59 x 45mm high. The large compartment will hold screwdrivers, soldering irons etc and measures 310 x 80 x 45mm high. When the lid is closed each compartment is sealed from each other and there are two slide catches to hold the lid closed. Total size is 312(W) x 220(D) x 50(H)mm. Colour is grey. Made in Australia.

NEW

Cat. #: HB-6315 **$16.95**

UNIVERSAL REMOTE CONTROL



Just about every piece of equipment you purchase today has a remote control. How many remote controls do you have lined up on your coffee table? This remote control will "Learn" the functions of most remotes so you can retire them all and use just one. It will control up to 5 devices any of which could be a TV, VCR, CD player, laser disk, cassette deck, amplifier etc. Other features include: •Backlit keyboard - all buttons light up for a short time at the touch of a button so it's easy to use in the dark. •Unique scan button for entering group commands or scanning through a sequence of commands. •Master power switch controls all devices at once. •Size: 155 x 53 x 26 mm.

NEW

Cat. #: AR-1705 **$89.95**

RECHARGABLE LANTERN BATTERY

This 6 volt 5AHr rechargable sealed lead acid battery suits those ever popular Dolphin style torches. Why waste money throwing away batteries. You've seen these advertised by others for $39.95. We've got them cheaper!

Cat. #: SB-2498

NEW

ONLY $32.95

UNIVERSAL RUBBER HOLSTER FOR DMM'S

This quality holster suits our large digital multimeters. It will protect them from drops and general rough treatment. It includes a tilting bail and can be wall mounted. It will suit the following DMM's: TES 3.75 digit - Cat QM 1475, TES Frequency DMM-Cat QM1520, Dual Display DMM -Cat QM1525, Meters 4.5 digit DMM-Cat QM1460 plus other full size meters with height about 185mm and width approximately 85mm. Holster size: 200 x 99 x 55(D)mm.

NEW

Cat #: QM-1510

$19.95

SILICON CHIP

REMOTE CONTROL PREAMPLIFIER KIT

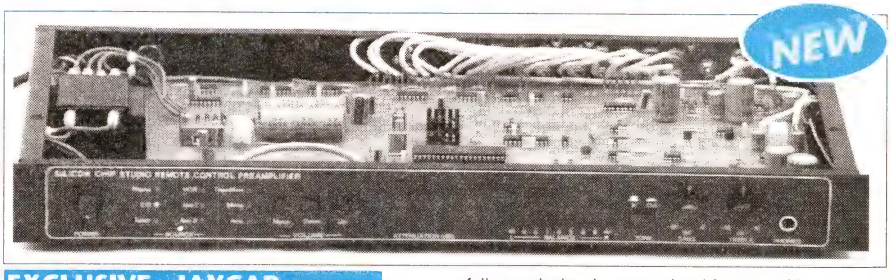
REF: SILICON CHIP SEP/OCT/NOV 1993

Jaycar Electronics is proud to announce this exciting new project from Silicon Chip magazine. Presented here is a project for any kit builder hungry for a challenge! The final result - a stereo preamplifier that incorporates the very latest in audio design technology. With over ten years of experience in presenting high performance audio kits, Jaycar has built an impressive list of projects such as the famous 8002 audio mixer, Black Monolith power amplifier, Series 5000 triad of projects, Playmaster & Studio series projects, AM/FM Digital Tuner and the list goes on. With a list this long, it's easy to see why Jaycar are the undisputed leaders in audio kit production. Our high performance audio kits are second to none. This new Remote Control Preamplifier is (of course) no exception.

The heart of this preamplifier is a Motorola microprocessor, and with only two PCB's, this kit is surprisingly straight forward to put together. An important feature is the remote controlled volume. Apart from convenience, the remote solves the problem of the volume potentiometer becoming increasingly noisy with constant use. A second problem with volume pots, is their poor tracking between channels, particularly at low volume settings. With this new Remote Preamplifier, no noise can develop because there are no moving parts in the volume control circuit, and the channel tracking and balance is excellent, even at low volume settings.

REMOTE CONTROL

Quite frankly we feel that the kit remote control simply does not do justice to the rest of the kit. It's very old fashioned looking compared to current remote controls. So, we have not included this kit remote with the main kit, but offer a pre-built unit as an extra. This has the ability to "learn" the functions of the preamp and will also control four other pieces of equipment. These could be your CD player, TV, VCR etc. So, not only do you gain another remote control, *you can retire all the others*. The remote control is pre-programmed for the preamp and has a unique backlit keyboard. All buttons light up for a short period of time at the touch of a button. If you purchase a kit and already have a learning remote, you can post it to us (including return mail costs) and we will program it for you *absolutely free!!!*

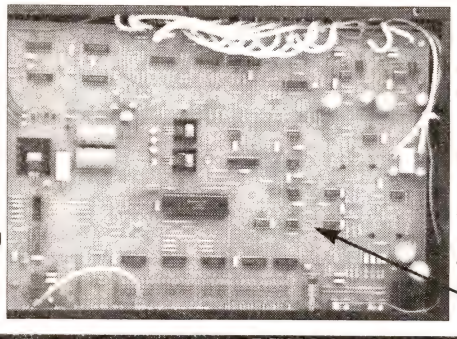


NEW

EXCLUSIVE - JAYCAR "BLUEPRINT" VERSION

Jaycar will of course be producing a standard version of this project. This version will include the fluorescent choke-type power transformer, nickel plated RCA sockets, Scotchcal panelling, carbon film resistors and standard screened cabling as well as the other parts specified in the projects part list. In addition to this, however, we will also be making available a fully Blueprinted kit which will include (but not limited to) the following features:

- •low noise radiation toroid power transformer
- •fully punched and screen printed front panel in distinctive "Blueprint" artwork
- •gold plated RCA sockets throughout
- •special low capacitance screened cabling
- •machined pin IC socket for the microprocessor
- •1% metal film resistors instead of carbon types



- pre-programmed microprocessor *included* in the cost
- pre-wound chokes
- metal thread fixing screws fixing inserts clinched into chassis. Beware of cheap chassis' that use self tapping screws!!
- specially written step-by-step instructions
- •remote control extra

PCB SECTION

STANDARD KIT

Includes all specified components except microprocessor and programming which must be obtained from Silicon Chip. No remote control.

Cat. #: KC-5140 **$419.00**

BLUEPRINT KIT

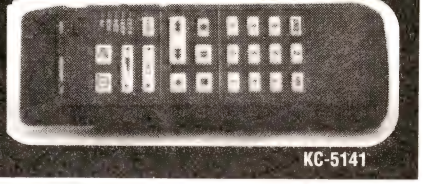
Kit as described including all the additional "Blueprint" features, including the pre-programmed microprocessor and without any remote control.

Cat. # KC-5142 **$489.00**

PRE-PROGRAMMED REMOTE CONTROL

As described elsewhere in this article.

Cat.# KC-5141 **$89.95**



KC-5141

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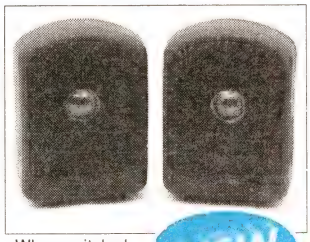
AMPLIFIED WALKMAN SPEAKERS

We now stock two pairs of Walkman speakers, both with built in amplifiers. They will make your Walkman cassette or portable CD sound great, and enable everyone to hear what's playing. We evaluated quite a number of these speakers before deciding on these two, which offer excellent sound quality and value for money.

NEW

STEREO SPEAKER SYSTEM WITH DXBB



These speakers have a built in amplifier which delivers a genuine 3 watts to each speaker. They incorporate the following features: •DXBB - Dynamic Extra Bass Band control system which extends the high and low frequency response without overloading the amplifier. A LED shows you when DXBB is working. •Double Bass and Treble switches. When switched on the Bass and Treble is double normal operation. •Power Switch / Direct In. The amplifier can be turned off and the unit acts as an ordinary stereo speaker system. Power handling is 3 genuine watts. •Speakers can be locked together for easier handling. •Use 4 x C batteries or 6VDC mains adaptor (not supplied - use model MP-3010 $19.95). •Gold 3.5mm stereo plug supplied. •Size: 155(H) x 110(W) x 60(D)mm.

NEW

Cat #: AS-2960 **$39.95/pair**

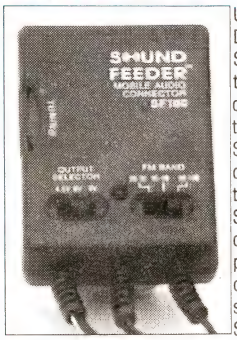
HIGH POWER STEREO SPEAKER SYSTEM

NEW

These are the big brothers to the AS2960. Their built in amplifier delivers a genuine 4 watts to each speaker. Features include Double Bass and Treble switches, power LED indicator, large cabinets for better sound.The amplifier can be switched off and the unit acts as an ordinary speaker system. Gold 3.5mm stereo plug supplied. Use 6 x C size batteries or 500mA plug pack Cat MP3012 $22.50.
Speaker size: 150(H) x 80(D) x 90(W)mm.

Cat #: AS-2962 **$49.95/pair**

CD/AUX TO CAR FM SOUND FEEDER



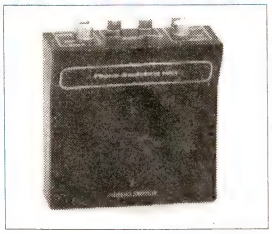
NEW

USE YOUR PORTABLE COMPACT DISC OR WALKMAN IN THE CAR!!! Sound Feeder is a convenient way to play your CD or Walkman on your cars stereo system. Sound Feeder converts the signal to FM which is picked up on your FM stereo receiver. Simply plug Sound Feeder into your cigarette lighter, connect the audio input wire to your portable player, tune in your FM receiver and you have STEREO sound. Sound Feeder also contains a DC to DC voltage convertor to drop the vehicles 12v to 4.5, 6 or 9v to power the portable player. Sound Feeder combination of stereo sound, easy installation, portability and power supply feature make it an ideal accessory for all cars. Supplied with four different DC power adaptors.

SPECIFICATIONS:

Operating voltage:	12-18VDC	Max input signal:	400mvppAudio
Consumption current: (no input signal)	22mA	input imp:	1 ohm
		Audio response:	50Hz - 15kHz
Tuning frequency:	88-108mHz	Size:	90(L) x 51(W) x 21(H)mm
Channel separation:	40dB	Cat #: AR-1750	**$47.95**

BUDGET AUDIO SWITCH



If your amplifier has not got enough inputs, this switch will help. It has two sets of RCA sockets for inputs and one set for output to the amplifier. This will allow two components (eg CD and Laser Disc) to be connected to the one amplifier input. Supplied in a plastic box with rocker switch for selecting input.

Size: 90(W) x 100(D) x 35(H)mm.

Cat #: AC-1656 **only $17.95**

NEW

NEW AUDIO CONTROLS

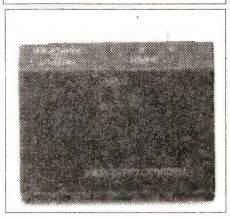
We are proud to introduce three quality audio switches. One is for input, the other two are for speakers. These are supplied in a heavy black anodised case with scratch resistant feet and gold writing.

NEW

2 WAY SPEAKER CONTROL

Have either or both speaker systems running with this switch. Simple screw terminals accept 79 strand cable. Suitable for speakers from 4 to 16 ohms.
Size: 125(W) x 110(D) x 45(H)mm.

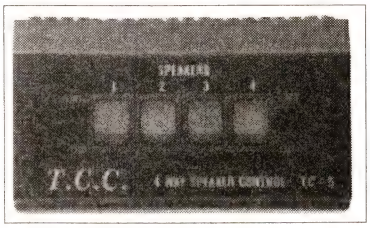
Cat: AC-1640 **$26.95**



3 WAY INPUT CONTROL

If your amplifier is lacking inputs - this will help. It has three sets of RCA sockets for inputs and one set for output to the amplifier. It will allow three components (eg CD, tuner, laserdisc, tape deck etc) to be connected to one input socket on the amplifier. This switch is about half the price of our old model.

Cat: AC-1658 **$26.95**



4 WAY SPEAKER CONTROL

Connect from one to four pairs of speakers. Screw terminals accept 79 strand cable. Suitable for speakers of 8 ohms and more, and the switch ensures that the amplifier load will not be less than 50% of the speakers used. ie: If 8 ohm speakers are used the minimum load will be 4 ohm which is sufficient for virtually all amplifiers

Cat: AC-1642 **$49.95**

MAGNAVOX 12W SENSATION LESS THAN HALF PRICE

We have purchased a quantity of the fabulous Magnavox 12W 12 inch speakers at a special price. This speaker is stocked by us and normally sells for $59.95. We have been able to slash the price to $29.95 a saving of $30.

Speaker Details

- Paper cone, foam roll surround, high temp 25mm voice coil
- 350g Barium magnet.
- Power handling:80WRMS.
- Freq range fo: 6000Hz,
- Sensitivity: 89.2dB/W/mt.
- Res. Frequency: 25.7Hz.

•QMS: 3.24 •QES: 1.12 •QTS: 0.83 •VAS: 362.1L.

Two box sizes - both sealed.

VOL (Litres)	50	100
Tuning Freq	73.8Hz	55.2Hz
Response Peak	6.01dB	4.13dB
-3dB Frequency	49.9Hz	38.6Hz
Qtc	1.93	1.52

Cat. CW-2122

Catalogue Price $59.95

Now Only $29.95

LOW PRICES ON CAR DOOR LOCKING SYSTEMS

We have changed suppliers and we are now stocking actuators that are made by the same people who make our quality car alarms. We have also been able to **reduce our prices**.

FOUR DOOR CAR POWER DOOR LOCK KIT
Consists of two master solenoids and two remote solenoids (masters are for the front doors so opening either front door will automatically unlock the other three doors). Also includes a full wiring harness to connect all doors and the power lock relay is also supplied. You can remotely control this system with our Remote Control Switch - Cat # LR-8822 $79.95 which includes two transmitters. Cat # LR-8830

was $169.50 now $119.50 save $50

SEPARATE ACTUATORS
If you own a two door car - you only need buy 2 actuators (2 masters or 1 master and 1 slave) and a power relay.

MASTER ACTUATOR	SLAVE ACTUATOR	POWER
Cat #: LR-8832	Cat #: LR-8833	LOCK RELAY
was $38.95	**was $36.95**	Cat #: LR-8835
now $28.95	**now $26.95**	**$29.95**
save $10.00	**save $10.00**	

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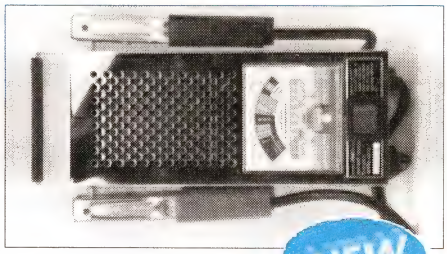
OUTDOOR GARDEN LIGHTS

NEW

150 LIGHTS!!! These are bigger, better and cheaper than our old model that we had so much trouble getting. Have the best looking garden in the street. Completely prewired - simply hang them through your garden. Safe, low voltage (24V) supplied with a mains 240v plug pack.The set consists of a 240v plug pack, 15 metres of plain cableand 21m of cable with the 150 globes at 140mm spacing. All cable & globe bases are green so it easily hides in the garden. Current drain for all 150 globes is approx 2.1 amps.

Cat.#: SL-2830 **$69.95**

BATTERY TESTER



NEW

This device will test both 6 and 12 volt conventional car batteries and maintainence free batteries as used in solar power installations etc. To accurately check batteries state of charge the tester draws current while measuring its voltage level. It will check batteries with ratings up to 1,000 CCA (Cold Cranking Amps) and can load batteries up to 100 amps. It will also check the batteries cranking ability, test the vehicles charging system output and test the starter motor. Its simple to use, completely portable, external power is not required and complete tests on a battery can be done in 30 seconds. Its accurate and dependable, with a shock resistant movement, heavy duty colour coded copper plated battery clamps and a heavy duty nickel-chrome plated steel case.

Size: 290(H) x 160(W) x 70(D)mm. Cat #: QM-1620 **$89.95**

VISION-MATIC GLASSES

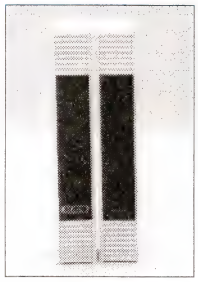
Vision-Matic are plastic glasses that incorporate one torch globe on each side for hands free illumination. They are ideal for many situations where the user needs a good torch light and both hands free. Use •for working on the car •camping •night reading •blackouts •night fishing, boating, walking etc etc. Vision-Matic glasses can be worn over conventional glasses. They require 2 x AA size batteries for each side (4 in all - not supplied). Globes are standard pre-focused torch globes. it also has a belt clip built in for easy carrying.

NEW

Cat #: ST-3025 **$14.95**

WHOLESALE DEPT: (02) 743-5222

WINDOW ALARM



This window alarm is the best unit we have seen by far. Most window alarms are hard to use, but not with this one. It's ideal for use on windows, doors, medicine cabinets, closets, stereo cabinets etc etc. It's easily attached with double sided tape or screws (both supplied). It has an instant trigger, loud beeping alarm, easy installation, no wiring, automatic alarm cut off after 30 seconds and it can be re-triggered. Requires 2 x AAA batteries.

NEW

This unit features a hidden switch which makes it easy to use and turn off.

Size (each unit): 131 (H) x 22(W) x 24(D)mm.

Cat: LA-5095 **$17.95**

DOOR WATCHDOG

After the success of our Electronic Watchdog alarm, we have found a much cheaper door knob model.

To use, simply place over the door knob on the inside and switch on. It's designed to be used on round type door knobs that are common in flats and newer homes.

As soon as someone touches the door knob outside, the unit starts barking like a dog. It is an excellent deterent, and offers inexpensive piece of mind for our older community, and people alone.

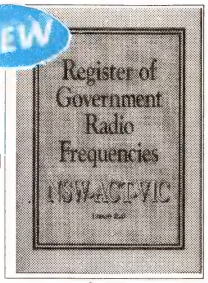
Features include: •simple operation - switch on to use •adjustable volume control •loud barking dog sound alarm •electronic touch activated sensor •adjustable sound volume. Unit requires a 216 9 volt alkaline battery (Cat: SB-2395 $6.30).

NEW

Cat: LA-5282 **Only $24.95**

REGISTER OF GOV'T RADIO FREQUENCIES - NSW/ACT/VIC

NEW



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PHONE EXTENSION LEAD

This lead has a 15 metre length of telephone cable with a U.S. 4 pin plug on each end. Also supplied are two adaptors. One accepts the U.S. plug and converts it to an Australian plug. The other adaptor is from the U.S. plug to and Australian socket. So you can have any combination of U.S. plug to Aust plug, U.S. plug to U.S. plug or U.S. plug to Aust socket all 15 metres long. Adaptors cost $6.50 each and the lead is about $8. That's over $20 value.

NEW

Cat #: YT-6050 **A BARGAIN AT $9.95**

AA NICAD BATTERIES

700mAh with solder tags - Cat. #: SB2451
$3.75 each

500mAh rechargable - Cat. #: SB-2452
4 for $10.00

500mAh with solder tags - Cat. #: SB2453
$2.95 each

700mAh rechargable - Cat. #: SB2450
$3.50 ea or 4 for $12.50

TV ANTENNA AMPLIFIER

Handy device designed for indoor use simply plugs into a power point. The antenna lead is plugged through the amplifier. Its ideal for low reception areas or installations where several TV's are being used from one antenna. •Adjustable gain: 0-20dB •Attenuation: -12dB •Max output: 98dBuV •Boost frequency: 40-900mHz •Noise: 5dB. This covers UHF, VHF and FM signals. Input / output is a coax TV socket.

NEW

Cat # LT-3282 **$49.95**

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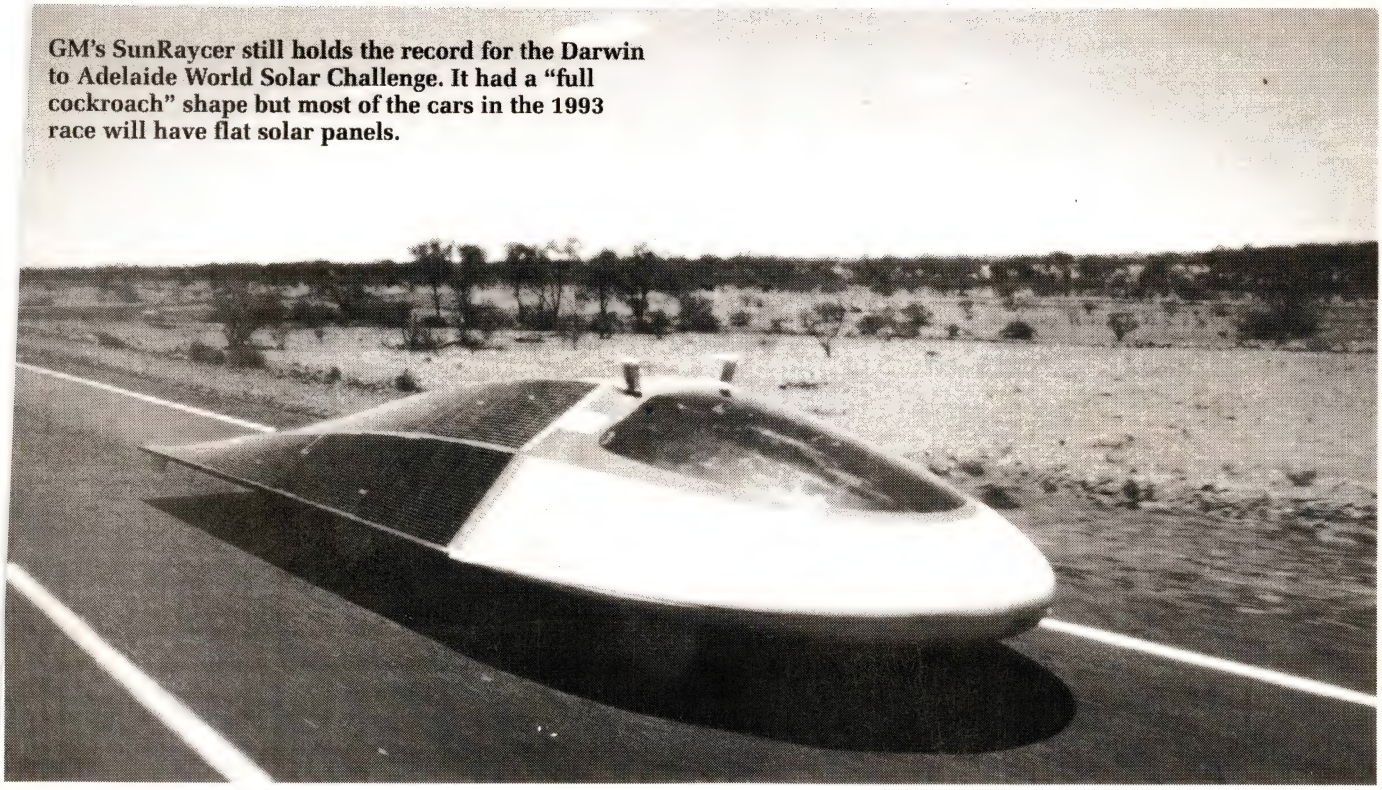


GM's SunRaycer still holds the record for the Darwin to Adelaide World Solar Challenge. It had a "full cockroach" shape but most of the cars in the 1993 race will have flat solar panels.

Darwin to Adelaide: technology makes it faster

The leading cars streaking south from Darwin on 7th November in the World Solar Challenge are expected to be able to cruise at more than 80km/h using just Sun power. With battery assist, they will be much faster, perhaps running at up to 140km/h.

By BRIAN WOODWARD

The progress in solar car technology since the last WSC in 1990 has been dramatic. Aerodynamic drag has been drastically reduced, rolling resistance lowered, electric motor efficiency improved significantly and power management exceeding 98% efficiency has been achieved.

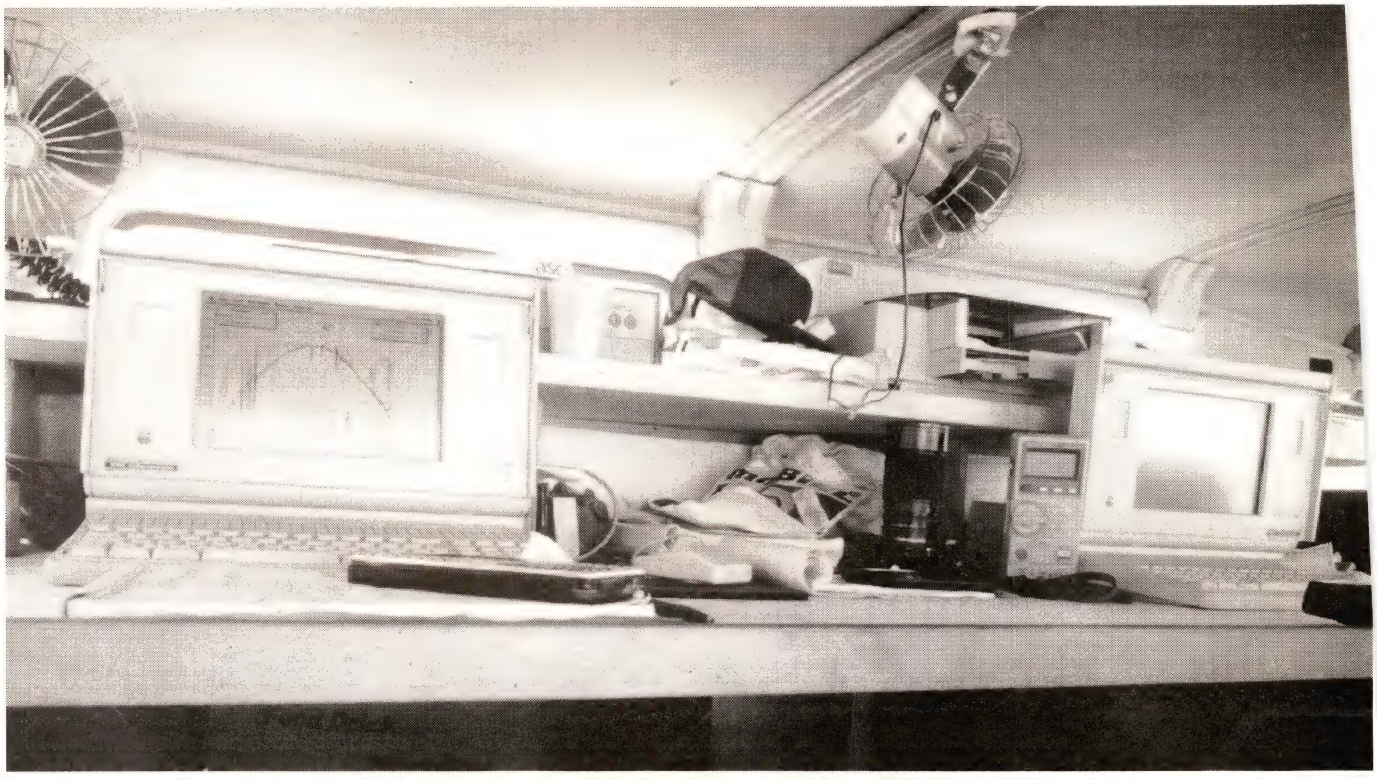
Solar cells have experienced the most dramatic change in the three-year period. The last race was won by the car entered by the Swiss Engineering School of Biel. This car used silicon solar cells developed by Professor Martin Green of Sydney's University of New South Wales. The revolutionary 'Green' cells offered a huge increase in power, but at a premium. Since the last race, Professor Green's team has been working with BP Solar to bring these new cells to a stage where they can be mass produced.

The result is dramatic. For a time it was thought that Australian innovation would once more miss the boat. Green cells may be efficient, acknowledged many industry commentators, but they were prohibitively expensive. Much less efficient, but very much cheaper amorphous silicon cells being developed in Japan were set to upstage the Green cells before they could reach mass production.

Now, Martin Green's breakthrough photovoltaic cells cost 15% less to make and offer 30% more power than conventional mass-produced solar cells.

Five years ago, mono or polycrystalline cells would have cost in excess of $20/watt to make. Costs have dropped to about $3/watt which relates to a retail price of about $10/watt – less than one third the price only a few years back.

BP Solar has supplied more than 40 kilowatts of cells to cars racing in the 1993 WSC. Unisearch, the research arm of the University of New South Wales, has supplied sufficient (more than 21% efficient) cells to power four



During the race, telemetry will be all important in monitoring the car's systems in order to extract the maximum performance from the solar cells.

cars. These are likely to be the front running favourites in the race because to clothe a race car in the very best cells costs more than $1 million!

A single seater three-wheeled race car will have an array of about 7.9 square metres of cells which, at close to 20% efficiency, will develop around 1500 watts in full sunlight. A few car syndicates are claiming more than this.

Cells need to be managed and "power trackers" do this. One of the best is the Australian made AERL tracker with a claimed efficiency of better than 95%. Some teams with lavish research laboratories able to construct one-off equipment are expected to have a tracker offering 99% efficiency at full power (when the semiconductor's temperature remains below 30°C).

Batteries are the big disappointment in solar racing. No significant improvement has been made in the past three years. One team has managed to improve the number of recharging cycles for red-hot racing batteries, but little else has happened in battery development.

There are two categories in the race – one for cars with lead acid batteries and one for cars with more elaborate batteries. Cars are permitted to carry five kilowatt-hours of stored power. 5kWh of silver zinc batteries are worth about $40,000 and under race conditions, these can take 10 recharges. Carefully managed, they may manage 30 cycles. After that, they're scrapped.

To be competitive, a team will need, say, three sets of these batteries – or about $120,000 worth – to cope with development, training and testing before the race itself.

Motor developments

Real progress has been made in electric motor design. At least three cars will have the motor inside the drive wheel's hub. A truly leading edge design will be a DC brushless motor weighing about 12kg and offering 2.5kW of continuous power or a staggering 11kW peak power (think of those poor MOSFETs under full load!).

Three teams are claiming efficiencies along the lines of 98% for the motor controller, 99% for the tracker and better than 96% for the motor. This will mean that these advanced vehicles will be able to claim better than 92% efficiency from the solar array to the road wheels.

One such car, the Northern Territory University's Desert Rose, has a motor of such efficiency that the team's leader, Dean Patterson, can state that the car is the most efficient motor vehicle ever built.

Drag & rolling resistance

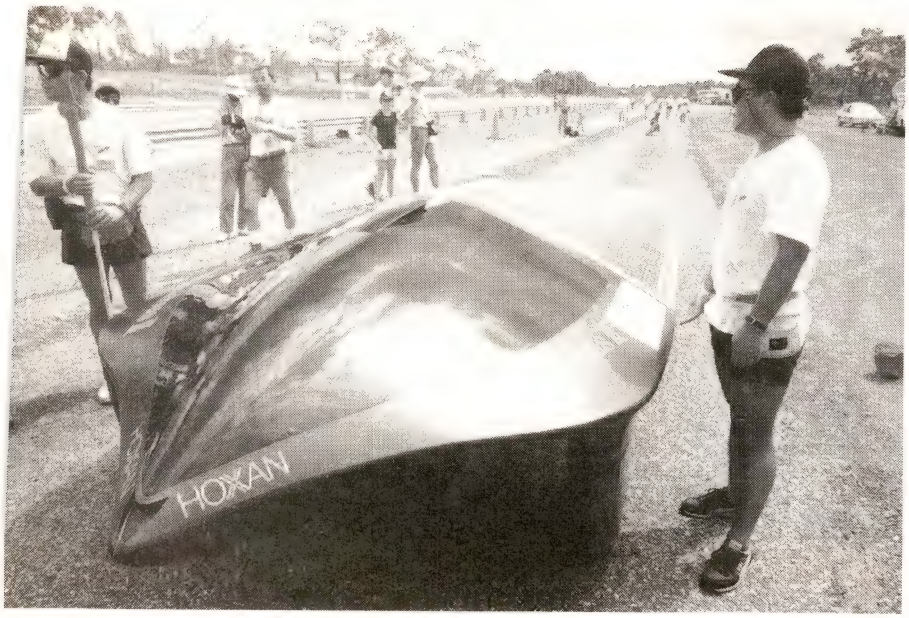
The last two factors which influence the success of a car are its aerodynamic drag and rolling resistance.

The Swiss Engineering School of Biel's team claims a reduction in rolling resistance for its tyres of 30% compared with conventional heavy duty bicycle race tyres. A section of the Northern Territory's Stuart Highway race course was moulded and shipped to Switzerland where an elaborate rolling road was constructed. At temperatures soaring above 40°C the new tyres were tested to destruction. At one stage the "Stuart Highway" broke, but the tyre survived!

Aerodynamics is the last area of technology to contribute to a win. With a frontal area of about 1.1 square metres and a drag coefficient (CdA) of 0.11, these cars have less drag than a fighter airplane.

One Australian car, the Aurora Q1 from Victoria, has just shifted the goal posts. Its frontal area is just 0.75 square metres and its CdA an amazing 0.095. This is almost certainly the first road registered vehicle to have an aerodynamic drag of less than CdA 0.1.

The performance which comes from this technology should result in a



One of the contenders in the 1990 WSC, this entrant from Hoxan really looked the part but it did not win.

This is a preview shot of the Aurora, from Victoria. This car is claimed to have a CdA of 0.095, an unheard figure up till now.

cruising speed of 80-90km/h in clear sunlight and perhaps 140km/h with the batteries approaching melt-down. A good set of batteries will take a solar race car 200-300km in cloudy weather, or even in rain. So power management tactics will play an important in the 3004km race from Darwin to Adelaide.

Part of the tactics is telemetry between the race car and its support vehicles. This technology has been accepted since the first event when the GM Holden SunRaycer's driver was told when to take on water and when to stop to visit the 'loo'. The support vehicle monitoring crew knew because telemetry was used to monitor the ambient temperature and humidity inside the race car.

How much do solar race cars cost? They start at $15,000 for some of the Holden-sponsored school teams and range up to an estimate of $20 million for some of the Japanese teams.

At the end of the last race, observers said that an improvement of 10% would give a car the winning advantage. At least half a dozen cars would appear to have made more than 30% progress over the 1990 race cars.

It will be interesting race. **SC**

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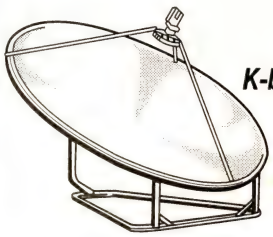

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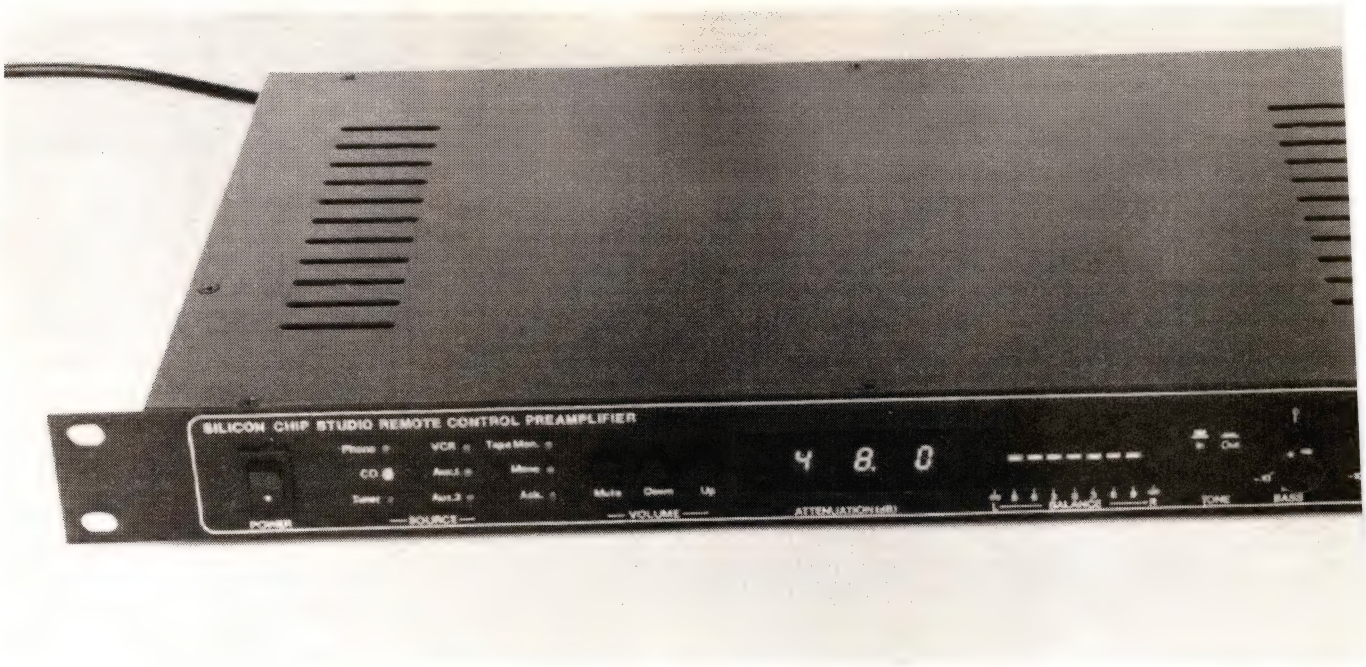


Stereo preamplifier with IR remote control

Despite its circuit complexity, the Studio Remote Control Preamplifier is easy to build. This month, we conclude with the full construction details.

PART 3: By JOHN CLARKE

The Studio Remote Control Preamplifier is housed in a 1-unit high black rack-mounting case. This is fitted with a screen-printed front panel which incorporates a smoke-coloured (neutral) Perspex window for the LED displays. A plastic film mask is fitted over the LED displays so that only the segments that have been lit are visible through the Perspex window.

Inside the case, most of the parts are accommodated on two PC boards: a main board coded 01308931 (350 x 230mm) and a display board coded 01308932 (243 x 25mm).

The handheld transmitter is housed in a small plastic case which has a front panel label measuring 73 x 63mm. It uses two PC boards, one for the electronic circuitry and the other to provide the necessary contacts for the switch membrane. This switch membrane is acted upon by 15 plastic-chrome buttons which protrude through the front panel.

Before starting construction, check all three PC boards for breaks in the copper tracks or shorts between tracks. Any defects should be repaired immediately. Check that all holes have been correctly drilled also.

Begin assembly of the main PC board (01308931) by installing all the PC stakes (at external wiring points), wire links and resistors – see Fig.7. Keep all the wire links straight to avoid shorts to neighbouring components. The 27Ω 5W resistor should be mounted about 1mm above the board to allow the air to circulate beneath it for cooling.

The ICs can be installed next, taking care to ensure that they are all correctly oriented. In particular, note that IC17-21, IC23 and IC15 are oriented differently to the remaining ICs, so check these carefully. We do not recommend using sockets for any of the ICs except for IC14 (the microprocessor IC), as this could prejudice the audio performance.

Once the ICs are in (do not plug IC14 in yet), install the diodes, regulators and capacitors, again taking care to ensure that all polarised components are correctly oriented. Note that the two 4700µF capacitors must be mounted on their sides as shown on

Fig.7, so that they don't foul the lid.

Exercise caution when mounting the three 3-terminal regulators, to make sure you don't get them mixed up. Each regulator is fitted with a heatsink and fastened to the PC board with a screw and nut. Use the largest heatsink for REG1 and smear all mating surfaces with heatsink compound before bolting each assembly to the board.

The relay, bass and treble pots, tone switch and headphone socket can now be mounted, followed by the 500kHz ceramic resonator and the 3.58MHz crystal. Do not mount LEDs 10-18 at this stage – that step comes later.

Finally, tack solder the six 6mm standoffs to their mounting points on the underside of the PC board. This is best done by first bolting the standoffs to the board, so that they are held in the correct positions.

Display board

Fig.8 shows the assembly details for the display board (01308932). Begin by installing the wire link, then install the PC stakes from the copper side of the PC board at the 1, 2 and 3 locations. This done, install the three 7-segment LED displays and the pushbutton switches. Be sure to orient each switch with the flat side of its body facing to the left and take care with the orientation of the LED displays (ie, bevel towards top left).

The infrared photodiode (IRD1) is mounted with its leads at full length and bent at right angles so that its front face sits vertically – see photo. LEDs 1-9 should only be inserted and not soldered at this stage, so that their height can be adjusted later. Be careful with their orientation, as LEDs 4-6 are different to the others. You can easily identify their leads because the anode lead is always the longer of the two.

Mating the boards

The main board is butted to the back of the display board at right angles and the two soldered together via matching connector tracks. Before doing this however, push LEDs 10-18 through their holes in the display board, then bend their leads downwards about 3mm away from the LED bodies, ready for insertion into the main board.

Now offer the front panel to the main board and insert the LED leads into their respective holes. This done, arrange the main board so that its underside is 1mm above the bottom edge of the display board, then lightly tack solder the boards together at a couple of mounting points. Check that the two boards are at right angles before soldering the remaining tracks together.

Finally, LEDs 10-18 can be soldered to the main board. Position them so that they sit flush against the display board before soldering their leads, and align them in a straight line to make a good bar display.

Transmitter assembly

Fig.9 shows the wiring details for the two transmitter boards.

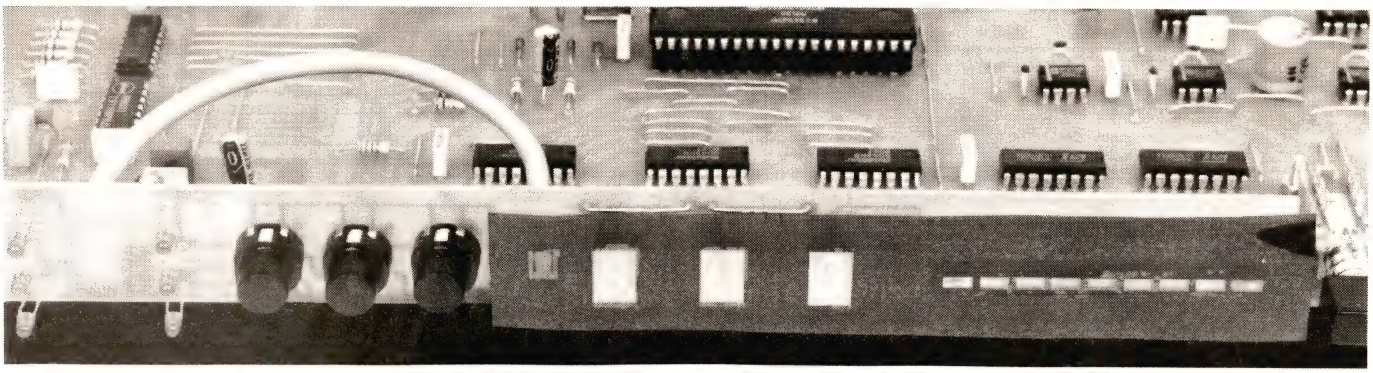
Before installing any of the parts, check that the two boards fit inside the case. In particular, the 01308933 board should be fitted to the base to check that the clips hold the board correctly and that the plastic alignment pin passes through the hole in the centre of the board. If the board is too wide for the clips, carefully file it down to size.

Once the board fits correctly inside the case, snip the top off the align-

CAPACITOR CODES

❑	Value	IEC Code	EIA Code
❑	0.22µF	220n	204
❑	0.15µF	150n	154
❑	0.1µF	100n	104
❑	.068µF	68n	683
❑	.015µF	15n	153
❑	.01µF	10n	103
❑	.0047µF	4n7	472
❑	330pF	n330	331
❑	100pF	n100	101
❑	39pF	39p	39
❑	22pF	22p	22
❑	10pF	10p	10

Below: a plastic film mask is fitted over the LED displays so that only the display segments are visible through the Perspex window. The photodiode sits behind a window in the mask to prevent reflections from the LED displays.



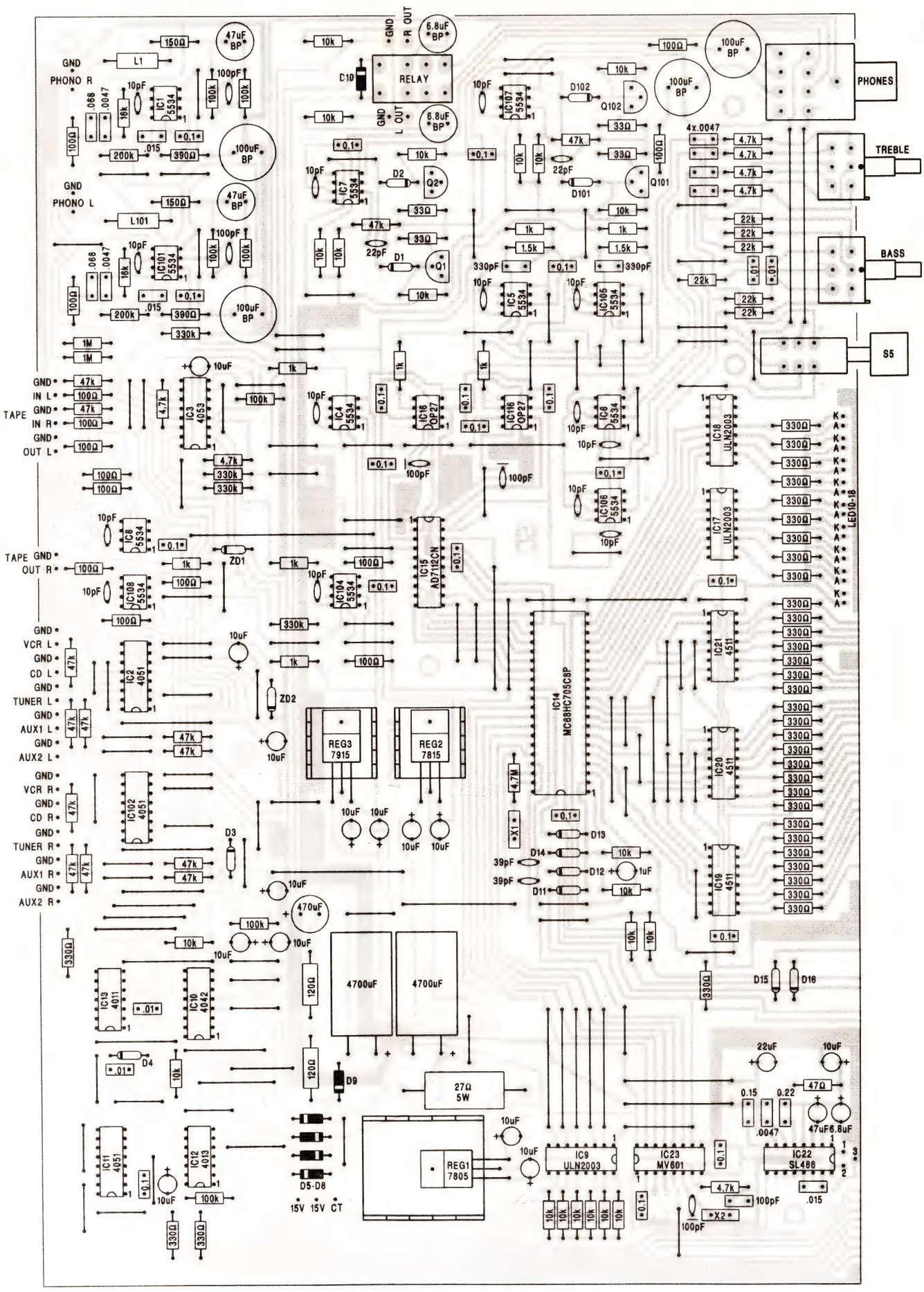
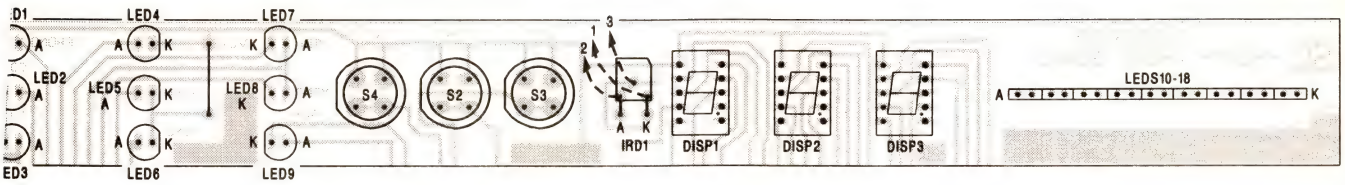


Fig.7: parts layout for the main PC board. Make sure that all polarised parts are correctly oriented a



g.8: parts layout for the display PC board. The infrared photodiode (IRD1) is mounted with its leads full length & bent at right angles so that its front face sits vertically – see photo.

ent pin with a pair of sidecutters so iat it is flush with the top of the oard. This will allow the IC to sit ver the alignment pin.

The switch matrix board (code 1308934) can now be tested in the id of the case. It mounts with the opper side towards the keys and is riented so that the wire entry points ire towards the front (see photo). Check that the PC board fits between he integral guides and is located correctly by the four alignment pins. File down the sides of the board if it does not fit comfortably.

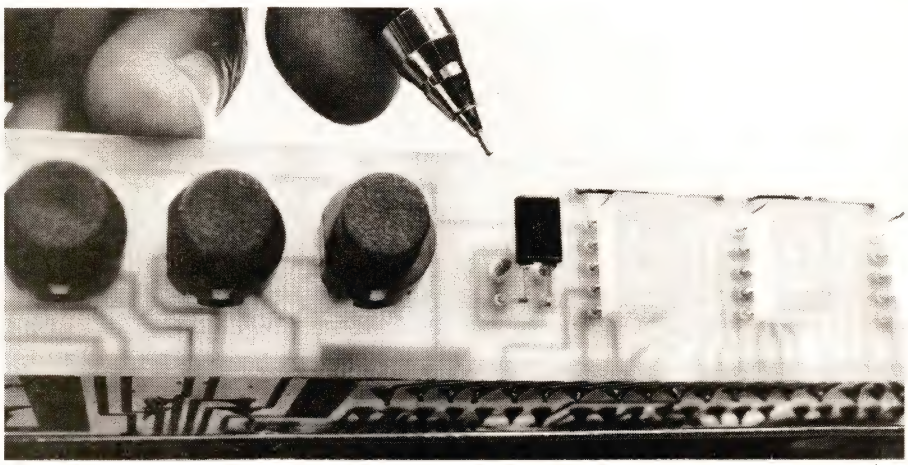
When everything is correct, begin the assembly of the components board by installing the IC, the links and resistors. This done, install the two 100pF ceramic capacitors, the 0.1µF capacitor, the 500kHz resonator and the battery clip leads. The 220µF capacitor must be mounted on its side, so that it will fit into the case.

Transistor Q1 is mounted with its leads bent at right angles and is bolted to the PC board using a screw and nut. The two LEDs are mounted without shortening their leads so that they can be bent to sit on the plastic cup rests at the front of the case.

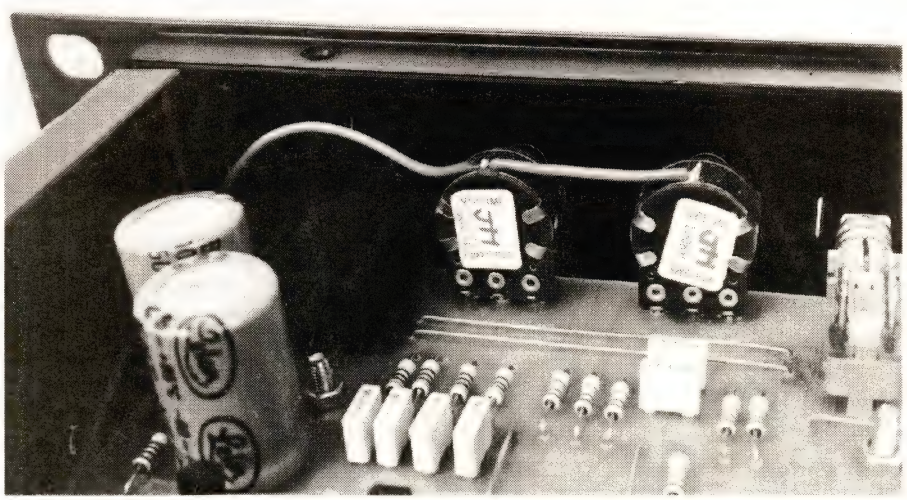
Assembly of the switch matrix board (code 01308934) simply involves installing the seven wire links. Once these are in, connect the 8-way 100mm-long rainbow cable to positions 1-8 and the 3-way 100mm-long rainbow cable to positions 9-11. The other ends of the rainbow cables are connected to matching positions on the components board.

The next step is to attach the front panel label to the case lid. This done, cut out the rectangular switch holes with a sharp knife and clean up the edges with a small file. The 15 chrome buttons are now installed from inside the lid and the membrane placed in position over these buttons.

The contact pads on the switch matrix board should be cleaned before it is installed in the case. Use some steel wool (not the soap pads)



This close-up view shows how the infrared photodiode is mounted. Make sure that the bevelled edge of the photodiode is at upper right.



The metal cases of the two tone control pots are earthed by connecting them together as shown here & running a lead back to the EXT EARTH socket on the rear panel.

for this job. Polish each copper switch pad area, then apply a smear of heatsink compound over the polished areas. This step will prevent the copper from tarnishing, which in turn would lead to intermittent operation of the remote control. Note that this treatment should also be applied to tinplated boards.

Now for the final assembly. Attach the switch matrix board to the case lid with six small self-tapping screws, then clip the components board into the bottom half of the case and bend the LED leads so that the LEDs sit on the plastic cup rests. Finally, feed the battery clip leads through to the battery compartment, then clip the case together and secure it with the self-tapping screw supplied.

Chassis assembly

Work can now begin on the preamplifier chassis. Assuming that all the chassis holes have been pre-drilled, you can secure the side and rear panels to the baseplate but leave the front panel off at this stage. The four rubber

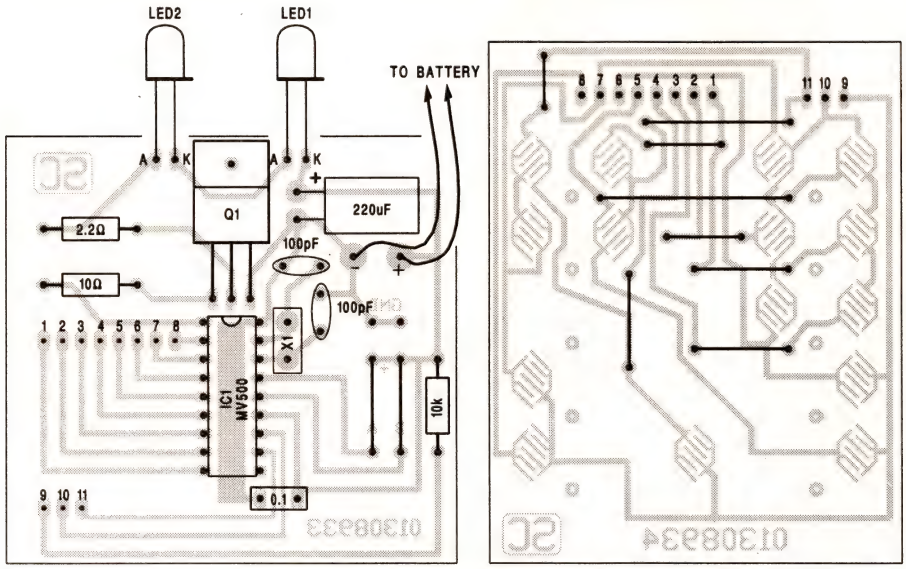


Fig.9: this is the parts layout for the transmitter PC board & its companion switch matrix board. The two are linked together via 8-way & 3-way lengths of rainbow cable. Note that the two infrared LEDs (LED1 & LED2) are installed with their leads at full length.

feet should be attached to the underside of the baseplate at this stage, to prevent scratches both to the chassis and to the bench top.

The 18 RCA sockets on the rear panel must be insulated from the chassis, either by using insulated sockets or by using non-insulated sockets which mount on an insulated subpanel. The earth terminal associated with these sockets (EXT EARTH) must also be isolated from the chassis.

Once these parts have been mounted, install the fuseholder, mains cord and cord grip grommet on the rear panel, then mount the power transformer, earth solder lugs, mains terminal block and power switch. Note that it will be necessary to scrape away the paint (or anodising) from the area surrounding the mounting hole for the earth lugs, in order to ensure a good chassis contact. Use a screw, n and star washer to secure the ea solder lugs, then use a multimeter confirm that they are indeed cc nected to chassis (the meter shou read zero ohms).

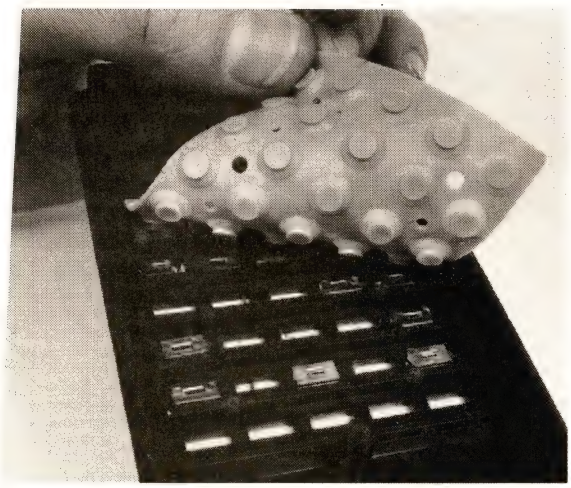
Check also that the rear and si panels are electrically connected earth by measuring the resistance b tween the chassis earth terminal ar each panel. If the panels are insulate from the baseplate, you may have t remove some of the anodising fro around their mounting holes.

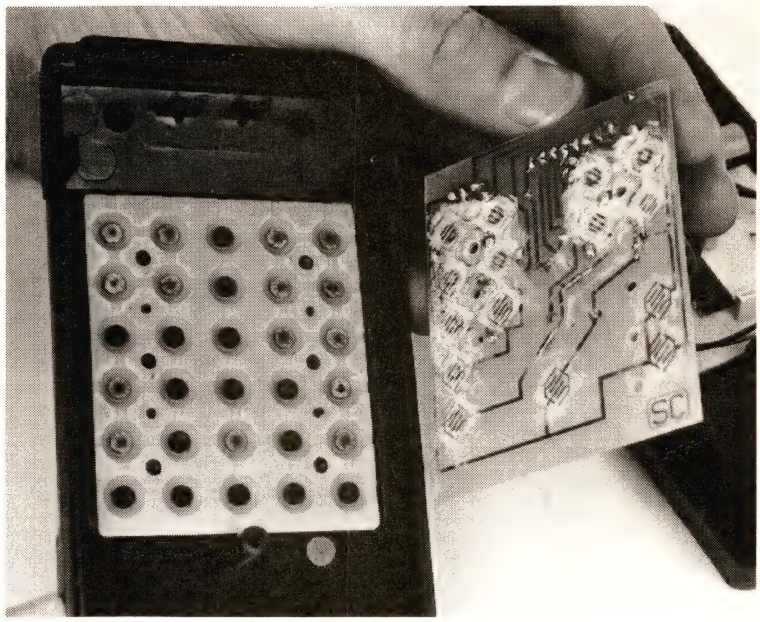
The next step is to fit the film mas to the LED displays using double sided tape. Arrange the mask so tha only the LED displays are visibl through the windows and positio IRD1 so that it is centred behind it allocated window – see photo. Whe this has been done, fit the front pane to the chassis and push the PC boarc assembly towards it, so that the vari ous switches and the two tone control pots protrude through their respective holes.

Assuming everything fits, the PC board can now be secured in position using machine screws and nuts. In some cases, however, it may be necessary to either file or shim the board standoffs so that all the components pass through their front panel holes without fouling.

RESISTOR COLOUR CODES

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	4.7MΩ	yellow violet green brown	yellow violet black yellow brown
❑	2	1MΩ	brown black green brown	brown black black yellow brown
❑	4	330kΩ	orange orange yellow brown	orange orange black orange brown
❑	2	200kΩ	red black yellow brown	red black black orange brown
❑	7	100kΩ	brown black yellow brown	brown black black orange brown
❑	14	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	6	22kΩ	red red orange brown	red red black red brown
❑	2	16kΩ	brown blue orange brown	brown blue black red brown
❑	23	10kΩ	brown black orange brown	brown black black red brown
❑	7	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	2	1.5kΩ	brown green red brown	brown green black brown brown
❑	8	1kΩ	brown black red brown	brown black black brown brown
❑	35	330Ω	orange orange brown brown	orange orange black black brown
❑	2	150Ω	brown green brown brown	brown green black black brown
❑	2	120Ω	brown red brown brown	brown red black black brown
❑	10	100Ω	brown black brown brown	brown black black black brown
❑	1	47Ω	yellow violet black brown	yellow violet black gold brown
❑	4	33Ω	orange orange black brown	orange orange black gold brown
❑	1	10Ω	brown black black brown	brown black black gold brown
❑	1	2.2Ω	red red gold brown	red red black silver brown





These photos show how the rubber membrane fits in position over the switch buttons in the transmitter case. The copper contact areas on the switch matrix board are smeared with heatsink compound to prevent corrosion & ensure reliable operation.

Once the board is finally secured, LEDs 1-9 can be pushed into the front panel holes and their leads soldered and trimmed. The bass and treble control knobs can also be fitted.

Chassis wiring

All that remains now is to complete the chassis wiring – see Fig.10. By far the most tedious part of the job involves the wiring between the RCA input sockets and the main PC board. This wiring must all be run using shielded cable, to prevent hum pick-up and minimise crosstalk between channels.

Note that the metal cases of the bass and treble control pots are earthed by running a lead back to the EXT EARTH terminal on the rear panel. This measure prevents the preamplifier from picking up hum whenever the tone controls are touched. It will be necessary to scrape away the anodising from the bodies of the pots in order to make good solder joints.

Be sure to use 250VAC-rated cable for the wiring to the mains switch, fuseholder and the transformer primary. The Active (brown) and Neutral (blue) leads from the mains cord are connected to the terminal block, while the green/yellow earth wire is soldered directly to one of the earth solder lugs.

Insulated sleeving such as heatshrink tubing should be used to cover the bare terminals of the fuseholder and the mains switch, to prevent accidental contact. Note that a 0.0047µF capacitor is soldered directly across the mains switch and this should also be covered in heatshrink tubing.

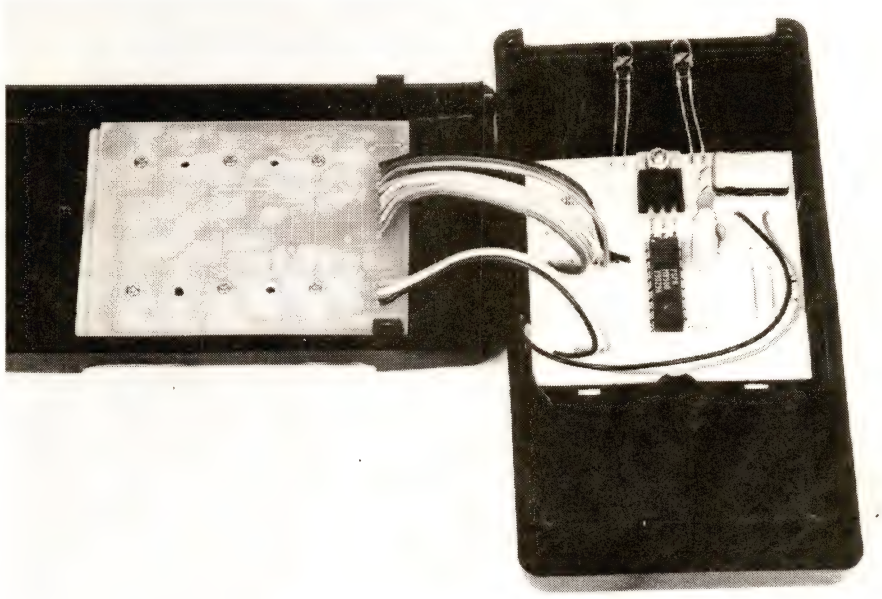
The wiring can now be completed by connecting the secondary terminals of the transformer to the PC board. This done, use cable ties to secure the internal wiring at various points. This is particularly important for the mains wiring, since it prevents any leads from coming adrift and shorting to the chassis.

Testing

Before applying power to the circuit, check your wiring carefully and re-check the PC board against the overlay diagram. Now apply power and check the supply rails at the output of each regulator. You should get +5V from REG1, +15V from REG2 and -15V from REG3. In addition, check that there is about 7.5V across each of the zener diodes (ZD1 & ZD2).

If you don't get the correct readings, switch off and correct the problem before switching on again.

Assuming that everything is OK, check that +5V is present at pins 1, 3, 37 & 40 of IC14's socket. If this checks out, switch off and install IC14, then



The switch matrix board is secured to the lid of the case using six small self-tapping screws, while the components board clips into position. Arrange the LEDs so that they sit in the small cups at the front of the case.

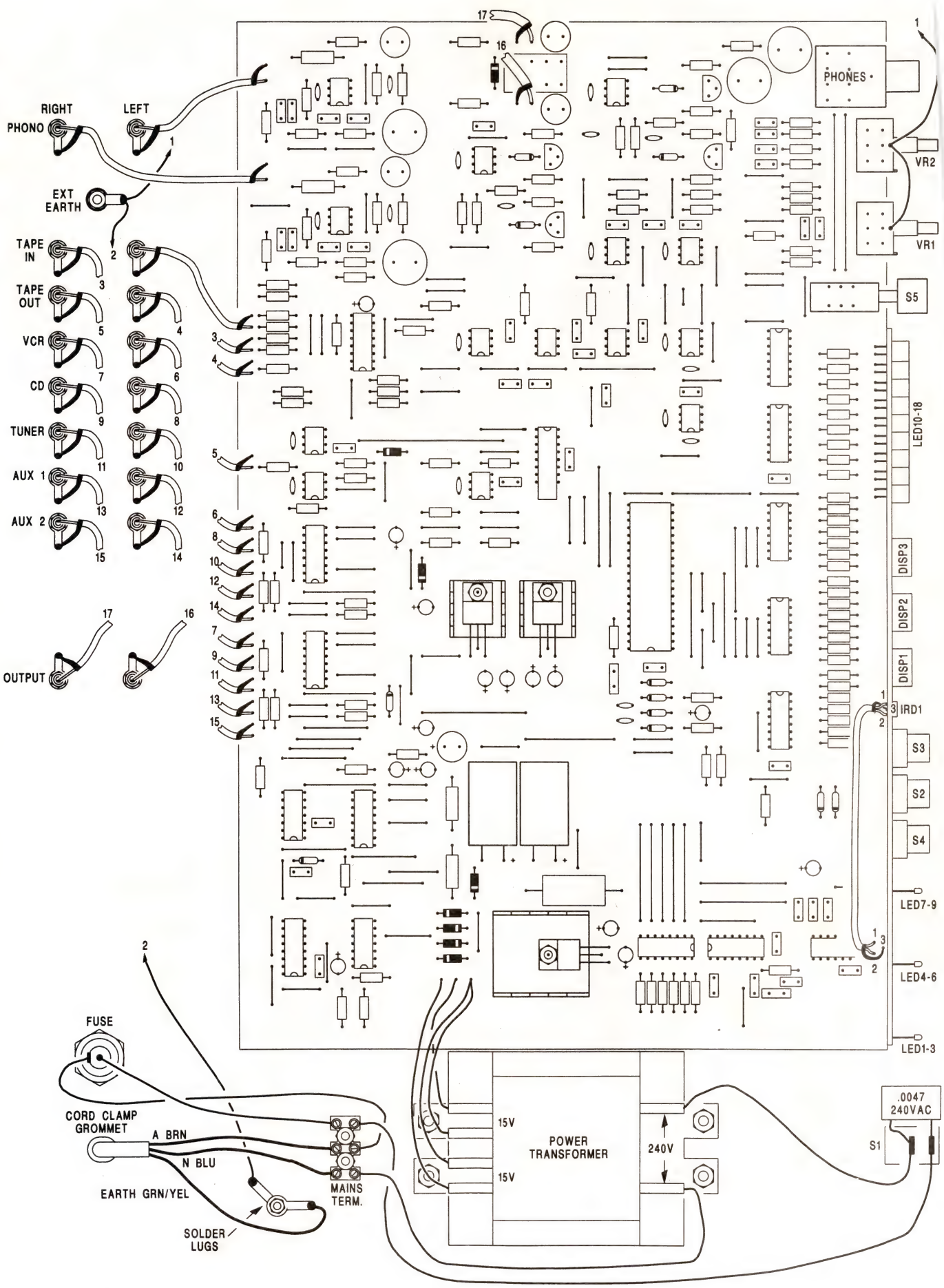
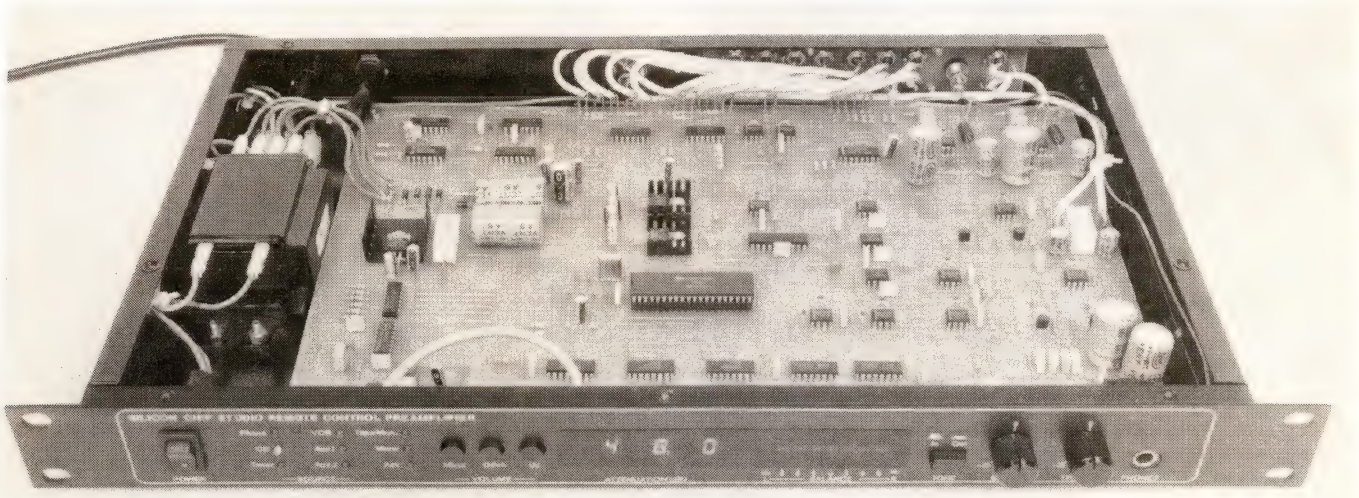


Fig.10: be sure to use mains-rated cable for all connections!



Use cable ties to secure the wiring at various locations, as shown in this photograph. Either insulated RCA sockets can be used or you can use non-insulated types mounted on an insulated sub-panel, as shown here.

apply power again. The Attenuation display should now show a reading of 48.0dB and the 0-9dB balance LEDs should all be lit. The CD LED should also be lit.

Now press the Mute switch on the preamplifier and check that all the balance LEDs except the 0dB LED extinguish. If this works, pressing the Up and Down switches should now alter the Attenuation display in 1.5dB steps. Note that pressing the Up switch will decrease the attenuation reading, while the pressing the Down switch will increase the attenuation reading.

The remote control handpiece can now be tested for correct operation. Check that the ACK (acknowledge) LED on the receiver lights when one of the remote control switches is pressed and that the appropriate LED lights when each of the Source switches (Phono, CD, Tuner, VCR, Aux1 & Aux2) is pressed. Finally, check that the Up, Down and Mute switches operate the displays correctly. Note that the balance adjustment is only available when the preamplifier is unmuted.

Note also that the balance display can show two LEDs lit at the same time. For balance settings of 0dB, 3dB, 6dB, 9dB and infinity, only one LED is lit but for in-between settings, two LEDs will be lit. For example, both the 0dB and 3dB LEDs will be lit for the 1.5dB setting.

The Tape Monitor, Source, Mono and Stereo selection requires some explanation. Initially, when power is applied, the selection is Source Stereo. You can then select Source Mono by pressing the lefthand Source switch and Source Stereo again by pressing the righthand Source Switch.

The Tape Monitor selection can be either "Tape Mon Mono" (by pressing the lefthand Tape Mon switch) or "Tape Mon Stereo" (by pressing the righthand Tape Mon switch).

Connecting it up

The Studio Remote Control Preamplifier connects between the signal sources (Phono, CD, Tuner, VCR, Aux1, Aux2 & Tape) and the power amplifier. In fact, it's no different from any other stereo preamplifier in this respect.

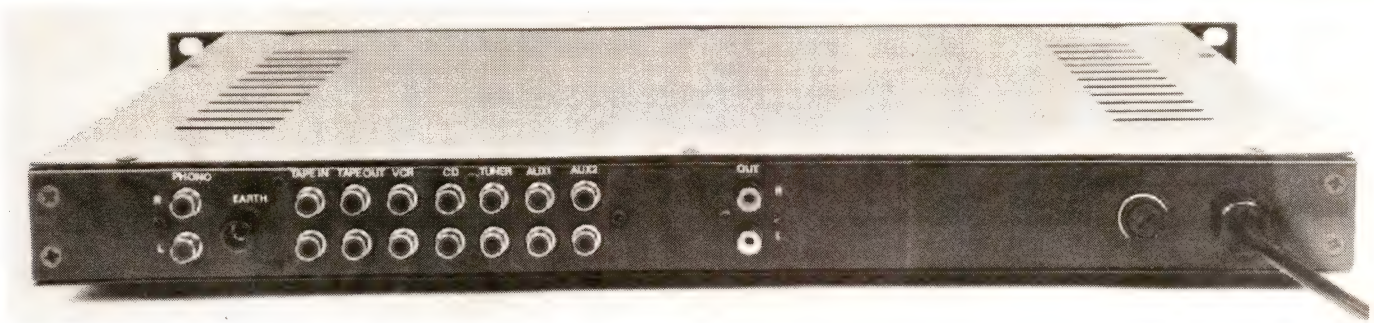
When all the connections have been made, switch on and check that you can listen to each source. Check that the volume, balance and tone controls function correctly and that plugging in a set of headphones switches out the loudspeakers. The sound from the headphones should be clean and there should be virtually no background noise.

Finally, check that there are no loud clicks and plops from the loudspeakers when the power to the preamplifier is switched on and off. A faint clicking sound as the volume level is changed is normal. **SC**

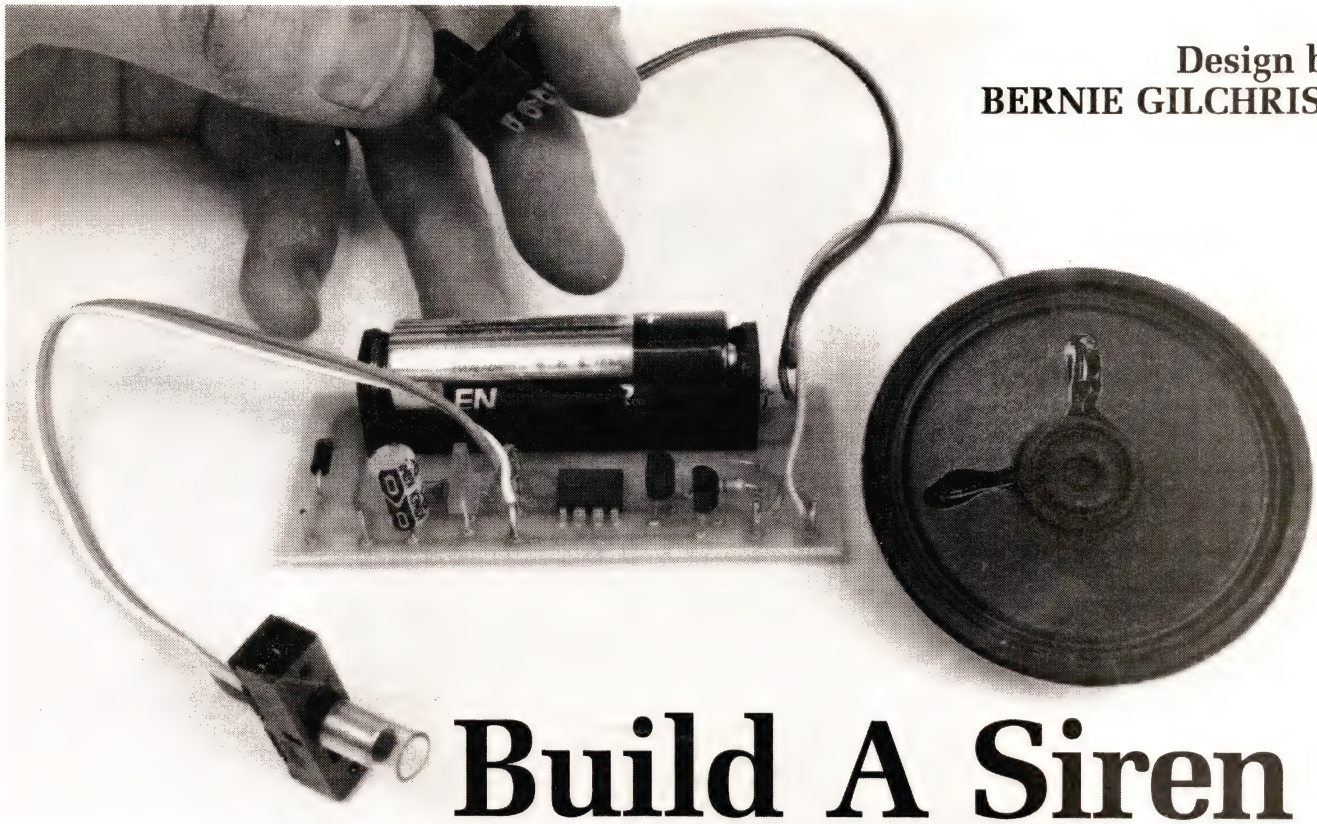
Where To Buy Kits

Readers are advised that kits for this project are not expected to be available until late November 1993 at the earliest. Kits will be available from Altronics, Dick Smith Electronics and Jaycar.

Below: the rear panel carries nine pairs of RCA sockets for the input & output connections, an earth terminal & the fuseholder.



Design by
BERNIE GILCHRIST



Build A Siren Sound Generator

This little circuit provides three siren sounds – Police, Fire Engine & Ambulance. By making a simple modification, it can also be made to produce a sound similar to a machine gun. It is powered from a single AA size 1.5V cell & is ideal for games & models.

At the heart of this project is the UM3561A, an LSI (large scale integration) device which includes a 256 x 8-bit ROM (read only memory) programmed to simulate the siren sounds via an internal tone generator and control circuitry.

The only external component that affects the pitch and timing of the siren sounds is the resistor connected between the OSC1 and OSC2 terminals (pins 7 and 8) of the IC and we've shown its value as 330kΩ. Reducing the value of this resistor will increase the pitch of the siren sound while increasing the resistor will have the opposite effect (ie, lower the pitch). Variation in the supply voltage to the IC also affects the pitch and timing but to a much smaller degree.

Pin 6 on the IC (SEL1) is used to select the siren sound and this is achieved by switching it high (Fire), low (Ambulance) or open circuit (Police) with 3-position slide switch S2.

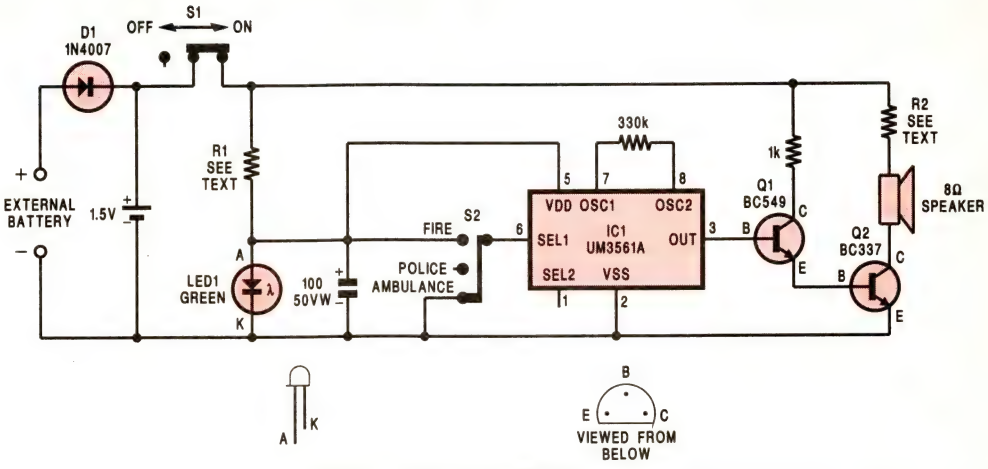
TABLE 1		
Ext. Supply	**R1**	**R2**
3V	560 ohms	link
6V	3.3k	10 ohms 1W
9V	6.8k	22 ohms 1W
12V	8.2k	27 ohms 5W

The output signal from the IC is a modulated pulse waveform which is roughly equal to the supply voltage in amplitude; ie, slightly less than 1.5V peak-to-peak. The output of the IC drives transistors Q1 and Q2 which operate as a Darlington transistor to drive the 8Ω loudspeaker. The current drain through the speaker is limited by resistor R2.

The value of R2 is a compromise between loudness and battery life. A lower value of resistor will make it louder but the battery life will be shorter. If you are using just the 1.5V cell as shown on the circuit and in the photos, you can replace R2 with a wire link. This makes the speaker quite loud but battery life will be relatively short. For an AA cell, we would expect the battery life to be no more than an hour or so.

The 100µF electrolytic capacitor connected between Vdd (pin 5) and Vss (pin 2) is used to decouple the IC from the supply to the output stage. This prevents the relatively high cur-

1: the circuit is based on M3561A LSI chip. This udes a 256 x 8-bit ROM ch is programmed to ulate siren sounds via an rnal tone generator & trol circuit. S2 selects ween fire, police & bulance sounds, while the kΩ resistor between pins 7 controls the pitch.



SIREN GENERATOR

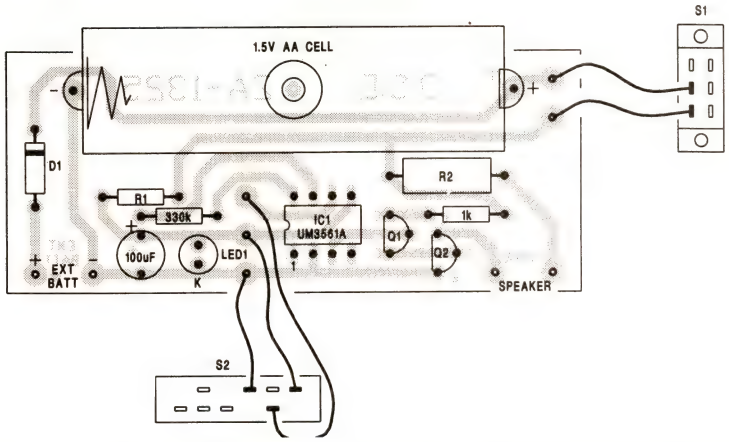


Fig.2: here's how to install the parts on the PC board. If you are going to power the circuit from a 1.5V battery, leave out D1 & LED1 & install links in place of R1 & R2. Alternatively, if you intend powering the circuit from an external supply, leave the battery holder out instead & choose R1 & R2 from Table 1.

rent being switched through the speaker from causing interference with the operation of the IC.

Three components, diode D1, resistor R1 and the green LED, are provided for use only with supply voltages of 3V or more. They can be omitted if the circuit is to be powered from a 1.5V battery. Diode D1 protects the circuit in the event that the supply voltage is accidentally reversed. Resistor R1 and the green LED form a 2.3V regulator to supply the IC.

Table 1 shows the suggested values for R1 and R2 for external supply voltages of 3V, 6V, 9V and 12V. Note that for the higher supply voltages you need to use a bigger speaker otherwise the power rating of the 50mm speaker will be exceeded. A bigger speaker sounds better too.

Finally, we should mention the modification necessary if you want to obtain the machine gun sound. This requires pin 1 to be connected to the Vdd rail (ie, pin 5). In this condition, the setting of the slide switch does not matter and the machine gun sound will be emitted in bursts. Our feeling is that most people will not be interested in the machine gun sound and will build the project only for the siren sounds.

Assembling the board

Putting the board together won't take long at all since there are so few parts. If you are going to power the circuit from a 1.5V battery, you will need to install the battery holder on the board and you can leave out D1 and LED1 and install links in place of R1 & R2. If you are going to power the board from 3V or higher, you will need R1, D1 and LED1 and you should leave the battery holder off the board. Fig.2 shows all these components on the board just to show their positions.

Make sure you install the transistors, the IC, the diode and the LED the correct way around and the same comment applies to the 100µF capacitor.

After the components are soldered in, carefully inspect the track side of the PC board for bad joints and solder splashes. You can then connect the battery or your external DC power supply and make siren sounds to your heart's content. **SC**

PARTS LIST

1 PC board, 77 x 33mm (DSE Cat. ZA 1325)
1 AA single cell holder
1 AA 1.5V alkaline battery
1 UM3561A IC (IC1)
1 BC549 NPN transistor (Q1)
1 BC337 NPN transistor (Q2)
1 green LED (LED1)
1 1N4007 diode (D1)
1 50mm 8Ω loudspeaker
1 SPDT miniature slide switch (S1)
1 3PDT miniature slide switch (S2)
1 100µF 25VW electrolytic capacitor
1 1kΩ 0.25W resistor
1 330kΩ 0.25W resistor

Note: see Table 1 for values of R1 & R2 if an external DC supply is to be used.

Where to buy the kit

This project was designed by Bernie Gilchrist of Dick Smith Electronics who own the copyright on the PC board. Complete kits will be available from all Dick Smith Electronics stores at $9.95. The catalog number is K-5514.

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Our customers throughout Australia are constantly amazed of our efficien and quality products. With services like a minimum 6 month warranty on products, overnight jet courier service (to capital cities and suburbs) and tl recent installation of a computerised mail order system, *ALTRONICS* is setting standards for others to follow. I invite you to try our fast mail-orde service. Just phone your order on 008 999 007 by 4.00pm EST and in most cases we can deliver to your door step the next working day!
Regards Jack O'Donnell

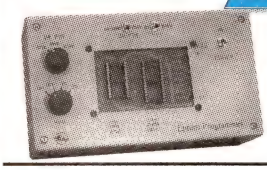
PC Based EPROM Programmer Kit

This is a great new kit for programming EPROM's from 2716 to 27256. Compares favourably against commercial units costing $$$ more. This kit puts you in the driving seat for under $ 100. It is flexible enough to be able to program 12.5, 21 and 25V EPROMS

A must for Every PC Owner!

K 9525 **$97.50**

NEW



Signal Comparator Kit

Have you ever had a faulty circuit that you have wanted to compare to an operational unit but been put off doing so because it is complex to do so. Well, this is a neat little kit that will allow you to compare the two units and give a differential voltage between them.

K 2563 **$39.95**

NEW

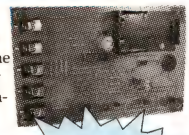
Quiz Game Adjudicator Kit

This kit will save all those disputes of who pressed the button first. Easy to build. In operation there are a maximum of 4 inputs via momentary switches. Built in LED's indicate who was the first to respond. Includes a buzzer to signal when a button is pressed.

Great for Board Games, Quiz Nights etc.

K 1132 **$33.75**

NEW



1 GHz Frequency Counter Kit

This the last kit run of our very popular 1 GHz counter which was published by Silicon chip back i '87. Grab your kit whilst there are still stoc left. Features professional screen printed perspex front panel, bright 7 segment LED displays, electronic switch latching etc. etc. Stocks limited.

K 2515 Normally $299.00

This Month Only $240.00

FM Stereo Transmitter Kit

(SC Oct '88) Simply connect your CD player or any other line level source to the mini transmitter which converts the audio signal to an FM signal.

Turn Your CD Player Into a Mini FM Transmitter!

This FM signal can then be tuned in via any FM radio. Great for listening to your favourite CD while washing the car, mowing the lawn or doing the vacuuming etc, without blasting the neighbours.

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The *MICRON* Series 2 soldering station employs electronic switch mode circuitry in lieu of a mains transformer. Excellent for all general purpose and production soldering.

Features:

- High insulation ceramic heating element in both rapid heat-up and instant recovery
- Heater insulation of over 100MΩ
- A zero voltage circuit ensures no high voltage spikes or magnetic field are present at the tip to damage sensitive components
- Continuous temperature adjustable from 250° to 430° C (480° to 800° F) • Grounded power cord

Selecting the desired operating temperature is as simple as turning a knob.

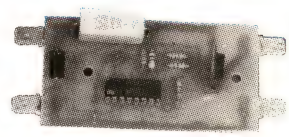
Simply choose the operating temperature required for the job and adjust the control to the appropriate setting. With its huge temperature range from 250° to 430° C this iron is suitable for most applications, from delicate double sided PCB's through to typical day to day jobs.

T 2443 **$129.95**

NEW

Just Arrived! A Soldering Station for Under $130

12V Intelligent Gell Cell Charger Kits



(SC July '89). This simple circuit will recharge your Gell Cells correctly, increasing their life span. Kit consists of one IC and a handful of external components plus the PCB. Charging current and voltage is controlled and over-charging is avoided by the IC switching off when the cell is fully charged. Two versions available for 12V and 6V gell cells. **Features:** • Automatic charge rate • Extends life of Gell Cells • Simple to construct • Supplied with chip details to allow experimentation & expansion of this kit • Dedicated IC

K 1685 12V Version
K 1686 6V Version **$24.50 ea**

Impedance Meter

Have you ever wondered if a transformers has a shorted turn and not been able to prove it. Or is that speaker transformer on the correct tapping. Well this little meter can now do that with digital reliability.

K 2550 Kit Version **$79.95**
K 2551 Fully Built-Up Version **$119.95**

NEW

Video Fader Kit

Here is a fantastic kit which allows you to create great fades and wipes when editing on your VCR. It can wipe left and right as well as fade to black or white. Complete with professional screen printed front panel and manual controls for fades and wipes. Simply plugs in between the two video machines when recording from one to the other.

K 5870
$32.95

NEW

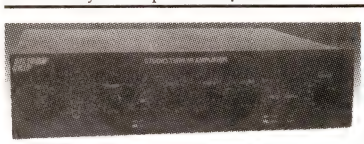
Makes Professional Fades & Wipes When Editing Videos

High Capacity Fast Charger for Nicad Batteries Kit

(SC Jan '91). This charger is designed to operate from a 12V battery. It can charge 6-12V nicad battery packs at up to 6A, or you can custom wire the unit to charge battery packs up to 30V at a reduced current. In operation the circuit will recharge a typical nicad racing pack in about 20 minutes. **Features:** • Fast charge rate • Switch selectable voltage setting in 1.2V steps from 6-12V • Fully punched and screened front panel • State of the art digital circuitry

K 1660 Normally $129.00,
This Month Only $99.00

Compact Stereo 50 + 50W Amplifier Kit



This fantastic amp has all the features of commercial units costing hundreds of dollars more. Using TIP 142/147 transistors it is capable of producing a total of 47 Watts per channel RMS into 8 ohms. Features 6 inputs, bass, treble and balance controls, headphone jack, tone defeat switch etc etc. Incorporates polyswitch protection.

Impress Your Friends with this Quality Stereo Home Amplifier!

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·0-45V Toroidal ansformers

A rating. Two dary windcan be wired e 90V at 1.78 , or 45V at 3.56 s. Ideal for lifiers etc. etc.

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Month Only **$55.00**

Only While Stocks Last!

60-0-60V Toroidal Transformers

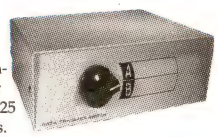
500VA rating. Two secondary windings, can be wired to give 120V at 4.1 amps, or 45V at 8.3 amps. Ideal for amplifiers etc. etc.

M 3150 Normally $129.00

This Month Only $110.00

Only While Stocks Last!

A-B Switch Box D25-D25

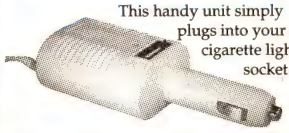


Two way printer-peripheral-computer switch with D25 female sockets. Allows two printers to be run off one computer and individually selected or allows one printer to be run off two computers and individually selected.

D 1570 Normally $49.95

This Month Only $39.95

Car Voltage Adaptor



This handy unit simply plugs into your car's cigarette lighter socket and presto! Gives you switchable 3, 4.5, 6, 7.5, 9 and 12V DC at up to 800mA. Includes a range of output plugs. Reversible polarity. Great for pocket TV's etc.

M 8150 Normally $16.95

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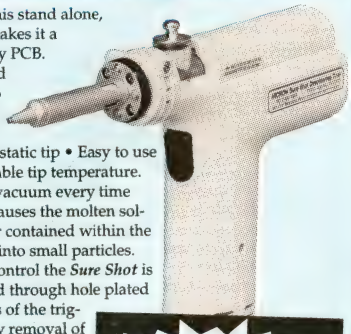

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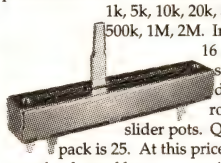

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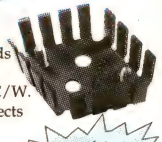

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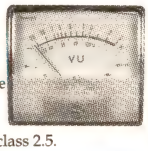

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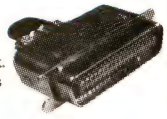

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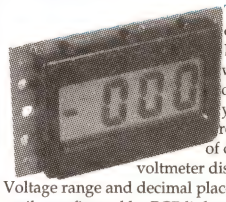

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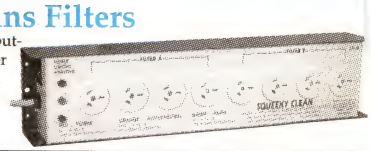

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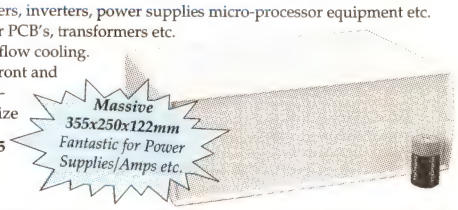

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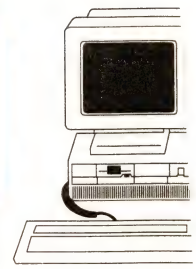
COMPUTER BITS

BY DARREN YATES



More experiments for your games card

Games cards are more than just entertainment adaptors – they can provide a simple interface between the outside world & your PC. In this article, we turn your games card into an 8-bit A/D converter using an op amp & a transistor.

When we came out with the first "Experiments for Your Games Card" article in January 1992, we looked mainly at using the existing circuitry on the card to accept analog resistive devices such as light-dependent resistors (LDRs) and thermistors.

Going back briefly to what we discussed, the games card essentially contains four 555 timers (in the one chip) which are connected up as monostables. The circuit in Fig.1 gives the general idea. The setting of the joystick provides the current which charges the .01µF capacitor. The computer then keeps a record of how long the monostable output is high, once it has been triggered, by incrementing an 8-bit register.

Fig.2 shows the pin-outs of the DB15 joystick adaptor socket. As you can see, it allows up to four analog inputs (via the joytick controls) and four digital inputs (via the fire buttons). Also included are two +5V supply rail pins and a number of GND pins.

Last time, we showed you how to connect an LDR or a thermistor into the card to measure light and temperature. This allowed us to measure analog signals "of sorts". The reason we say this is that using this method, you can't just apply an analog voltage directly onto the input and that all comes down to the fact that we have to charge up a capacitor in the 555 circuit on the card.

Since a capacitor charges up linearly with current and not voltage, this makes it a bit difficult. Also, if the capacitor doesn't rise above +3.3V (ie. 2/3Vcc), the 555 will never reach its threshold and switch off after it has been triggered. It is this turning off which tells the computer to stop counting. If we did feed a direct analog voltage into the joystick inputs, t circuit would not respond until t capacitor's voltage rose above +3.3

However, we can solve that wi the simple circuit shown in Fig. Using one op amp and a transistor, v can turn the joystick input into a mo est fractional 8-bit analog-to-digit converter or ADC. And since the jo stick port comes with four analog i puts, this gives up to four channels.

Putting it simply, the op amp an transistor form a voltage-to-currer converter which turns our analog ir put voltage into a current which the charges up the 555's .01µF capacito VR1 adjusts the output current to ob tain the best display. Notice that w are obtaining the 5V supply for th circuit from the games card (pin 1) The op amp used is an LM358 dua package so by using just another tran sistor, you can get a second channel.

By using BASIC's STICK command, it's a simple case of reading off the 8-bit number from that command to retrieve the digital code produced by the games card.

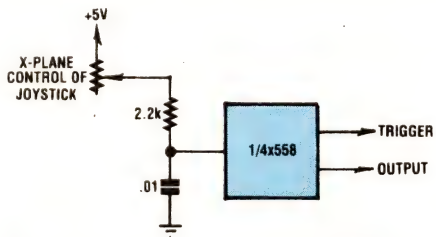


Fig.1: the input control circuitry for a typical games card. There are four such circuits to cover all the controls on a joystick.

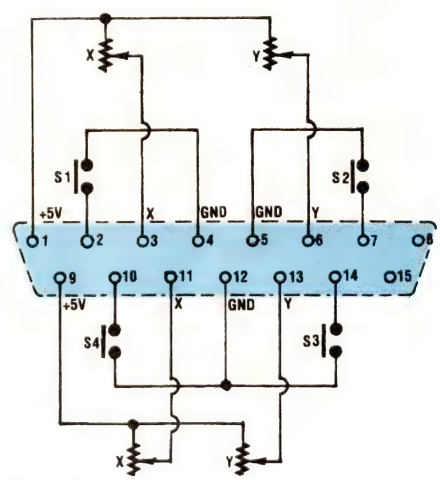
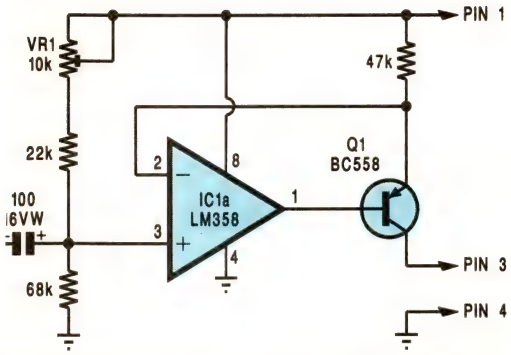


Fig.2: the pin connection details for the DB15 sockets on a games card.

Low-frequency scope

Putting this into practice, we wrote a small program to use the card as a low-frequency oscilloscope. Because QBasic is quite slow and the STICK command even slower, the upper frequency limit is only 10Hz. This is because QBasic can only take 40 readings from the joystick every second – even with a 40MHz 386DX. This necessitates the use of a 100µF capacitor on the input so that low-frequency signals are not reduced in amplitude.

Be that as it may, the display in Fig.4 shows the results of the program. Even though 10Hz is a low frequency, the circuit is still useful because it can be used to measure long term changes in circuit voltages, for



;.3: this simple circuit functions as a voltage current converter & connects to one of the /stick pot inputs.

ı all-up cost of about $2 in parts! The aximum input signal is 400mV p-p r a sinewave and 200mV for a square-ave. Any more than this and the ıystick counter register gives errone-us results.

With the components specified, ıere is a range of about 80 to 170 on ıe 8-bit range. It still has 8-bit resolu-ion – but not over the full range of 0 o 255. No, this isn't eight bits but it's ıot bad for $2.

Programming

Since January 1992, DOS 4.01 and DOS 5 have gone by the wayside and we've moved into the era of DOS 6. This means that many machines will have QBasic instead of GWBasic, although the following tips are equally valid in both. However, if you're still working with GWBasic, you may want to take a look at QBasic.

Even though QBasic is only an interpreter, it is a big improvement on GW-Basic and it has an easy-to-use screen editor and no line numbering!

The STICK command makes programming the games card quite easy and takes the work out of having to count up registers and examine inputs and all the nitty gritty. It works as follows. When you want to take a reading of the joystick port, you have to use the STICK(0) statement. When the program implements STICK(0), it not only records the x-input from the first joystick, it also takes a record of all joystick inputs. The good thing about this is that if you decide to use all four inputs as ADCs, this system won't travel any slower.

STICK(0) holds the x-input from Joystick A, STICK(1) the y-input from joystick A, STICK(2) the x-input from joystick B and STICK(3) the y-value from B, but you must use STICK(0) first. For example, let's say we wanted to take 640 samples from the last two joystick analog inputs; ie, the x and y inputs from joystick 2 and store them in an array for future use. These correspond to the commands STICK(2) and STICK(3). A simple BASIC routine is as follows:

```
DIM SAMPLE1(640),SAMPLE2(640)
FOR NUMBER = 1 TO 640
TEST=STICK(0)
SAMPLE1(NUMBER)=STICK(2)
SAMPLE2(NUMBER)=STICK(3)
NEXT NUMBER
```

Note that we must first perform a STICK(0) command before we can get information from STICK(2) or STICK(3). By using DEFINT SAMPLE1, SAMPLE2, you can speed up the program by 5-10% since operation on a single-byte integer variable is faster than floating-point variables.

To save these arrays as a file, you could use the following routine:

```
OPEN [FILENAME.EXT] FOR OUTPUT AS #1
FOR NUMBER = 1 TO 640
PRINT#1,SAMPLE1(NUMBER)
PRINT#1,SAMPLE2(NUMBER)
NEXT NUMBER
CLOSE #1
```

The data is then saved in the following format:

```
SAMPLE1(1)
SAMPLE2(1)
SAMPLE1(2)
SAMPLE2(2)
SAMPLE1(3)
```

and so on. By replacing the OUTPUT and PRINT statements with INPUT, you can retrieve this information out of the file, for use in another program. In fact, this is a very basic model of how audio signals can be retrieved from extremely noisy signals using noise averaging techniques. The stored data is fed through an algorithm which manages to remove the noise component and retrieve the original signal. You may even want to try having a crack at it if you have the relevant information.

The program CRO.BAS produced the diagram in Fig.4 and can be run from QBasic or, if you have access, on a BASIC compiler. This will speed things up to a degree, particularly if you use Turbo Basic from Borland. If push comes to shove, you could probably get it to work on GWBASIC provided you add in the line numbers.

The listing is too long to include here but we can provide a copy of the file on disc, as well as a complied version called CRO.EXE. If you would like a copy, write to SILICON CHIP, PO Box 139, Collaroy, NSW 2097. The cost is $10 (incl. p&p) and payment can be made either via cheque on by quoting a credit card number. Please indicate whether you require a 5.25-inch or 3.5-inch disc. **SC**

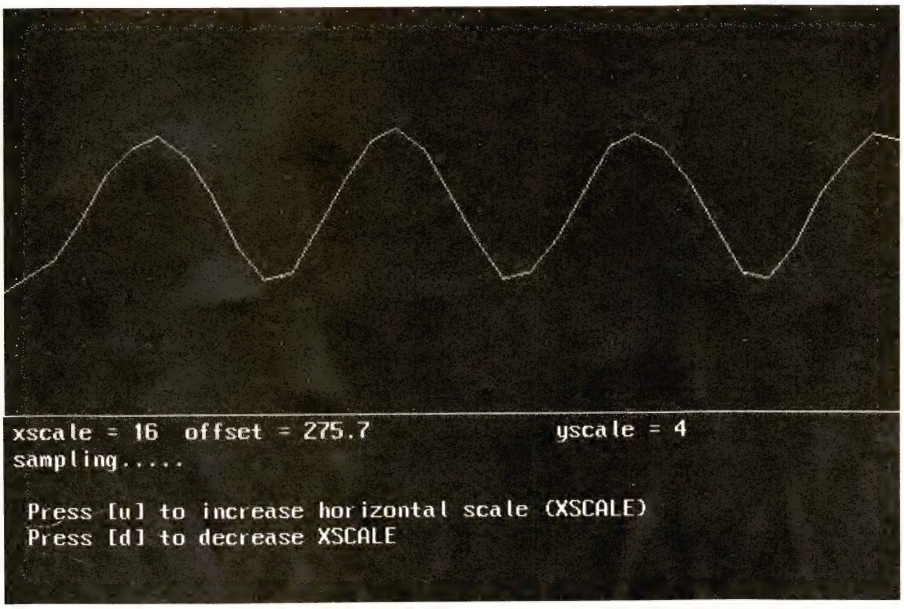


Fig.4: this sample display of the output screen is for a 5Hz 100mV RMS sinewave input signal. The on-screen instructions tell you how to expand or compress the x & y axes (note: instructions not shown here for the y axis).

Equipment Review

Epson's new Stylus 800 InkJet printer

If you're tired of your old noisy dot-matrix printer but can't afford to upgrade to a laser printer, you should take a good look at Epson's new Stylus 800. With 360dpi graphics capability & quiet operation, it has most of the features of a laser printer but at a lower cost.

Review by DARREN YATES

Inkjet printers combine the simplicity and economy of dot-matrix printers with the resolution and whisper quiet operation of the laser, without the high initial cost. As well, one of the major benefits of the inkjet printer is access to the same high quality graphics as a laser printer.

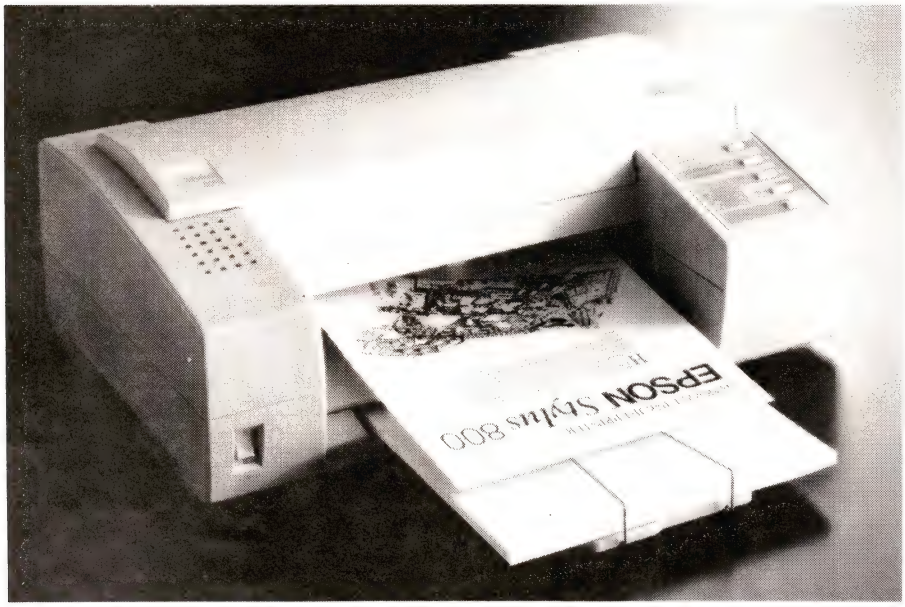
Epson has recently released the Stylus 800 inkjet printer which is designed as a first-buy printer for homes and small businesses. But don't think that means that it's small on features.

The Stylus 800 is claimed by Epson to be a revolutionary printer thanks mainly to its Multi-Layer Actuator printing head. If you've had a look at inkjet printers in the past, you may have seen evidence of smearing around the edges of the characters. This occurs because of the way in which the jet of ink is sprayed onto the paper at a precise position.

However, Epson has developed new head to "spit" and "cut" the ir droplet so that it doesn't spray. It hel to improve the output and make nearly indistinguishable from a las printer. This makes it suitable for higl definition graphics as well as stanc ard text.

The Stylus 800 uses a small in cartridge which is claimed to las around 700 pages at 1000 character per page and, unlike laser printer car tridges which are quite expensive, re placements are available for only $28 including tax. This makes running ar inkjet printer about as cheap as a dot matrix printer.

Epson has redesigned the printhead section from their SQ-870/1170 series so that the Stylus 800 has a permanent print head which requires replacement of the ink supply cartridge only. If you run in economy mode, which effectively uses less ink, the cartridge life can be further extended. This mode is ideal for draft printing work and is quite adequate for most letters, essays, school assignments and so on.

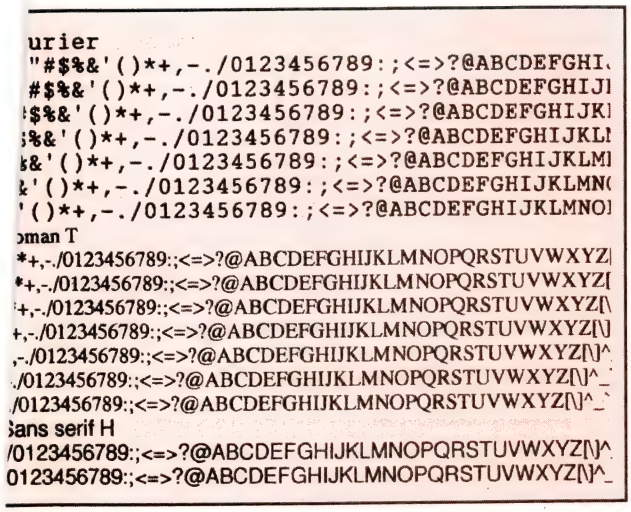


Epson's Stylus 800 inkjet printer is quite a compact unit which is capable of producing good quality graphics. It has seven resident fonts & can produce superscripts, subscripts, outlines with & without shadow, & underlining.

Features

For people with a shortage of desk space, one of the attractive features of the Stylus 800 is its size – it's only 435 x 264 x 154mm which is not much larger than Epson's old LX-400 9-pin printer. All controls except the power switch are on the front panel for easy access as well as all the status indicators. There's even an "ink low" indicator to tell you when it's time for a new cartridge.

Inside, it has seven resident fonts including Courier, Script, Prestige and Roman but Epson's new ESC/P2 printer control language also gives



self-test function is built into the Stylus 800 & is tivated by holding down the FONT button while the ower is turned on. Above is just part of the resulting rint out, shown about 75% of actual size.

ccess to scalable fonts from 8 to 32 point, as well as nhanced graphics. Other printing enhancements include superscripts and subscripts, outlines with and vithout shadow, and underlining.

Although the printer is so new that few programs as yet vill have a direct Stylus 800 printer driver, it operates extremely well using the LQ-870 ESC/P2 driver available n Windows 3.1. This means it can be used with a large number of drawing, CAD and desktop publishing programs with laser-like performance whilst retaining dot-matrix compatibility.

It also has a 100-sheet paper tray and automatic sheet feeding, as well as single sheet manual feeding from the rear. The one thing Epson has left out which we would have liked is a tractor feed option.

Because it is designed as a high-quality graphics printer, it doesn't have a high-speed draft mode. However its speed is still a respectable 180 cps at 12cpi and 300cps at 20cpi. And of course, its whisper quiet operation makes it a delight to have sitting next to the computer.

Connection to your PC is via the standard Centronics port, but if you use Epson Connect!, you can also run it from an Apple Macintosh.

Impressions

Our overall impressions of the printer are quite favourable. In just the short time we have had the Stylus 800 here in our editorial offices for review, it was quickly pressed into service once we realised its potential. On the noise-level front, it is just so much quieter than a dot-matrix printer that the cost of slightly reduced printing speed is worth the peace and quiet! It's also quite a good deal smaller than a laser printer yet more than capable of producing high-definition graphics, including circuit diagrams and front panel artworks!

The Stylus 800 retails for $649 plus sales tax where applicable and, as we mentioned above, ink cartridges are available for $28. For more information about the Stylus 800 and other InkJet printers, contact Epson Australia, PO Box 410, Frenchs Forest, NSW 2086. Phone (02) 452 0666. **SC**

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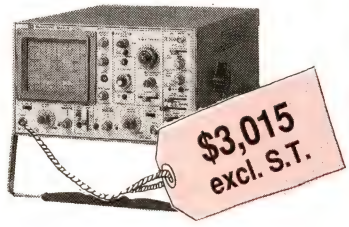

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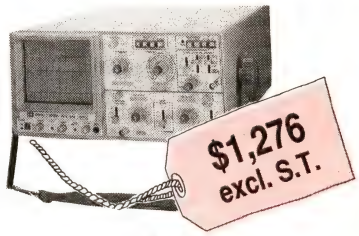

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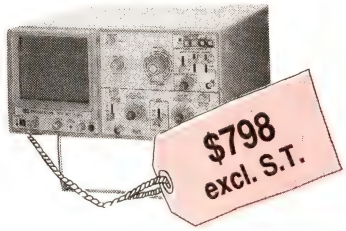

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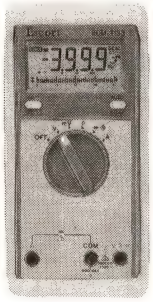

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- **Compatible with PC, XT/AT**
- **Elegant appearance and durable mechanism.**

Auto-return centering with fine tuning to adjust stable zero.

- **Accurate and stable performance.**
- **Long life variable resistorcontrol.**
- **Long Life fire switch**

C14204.....$24.95

LAY-BY NOW FOR CHRISTMAS!

AVIATOR 5

- **Authentic aircraft control yoke**
- **Automatic control yoke centering**
- **4 positive response fire buttons**
- **Realistic altitude/level indicator**
- **2 dual speed Turbo fire buttons**
- **X and Y axis trim control switches**
- **6 foot cable with 15 pin connector**
- **Stablizing suction cups**
- **6 U.S Military insignia stickers**

C14250.....$89.95

*** 386 & 486 machines require additional Smart games card.**

C14200.....$39.95

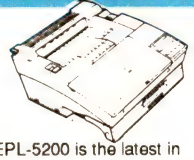
EPSON SYLUS 800 INK JET

- High quality. Epson's new ink technology delivers crisp 360 x 360 dpi text & graphics
- Flexablbe paper handling. With built in paper feeder to load up to 100 sheets automatically
- Fast printing speed. Print up 180 cps in 12 CPI leter quality mode.
- Very quiet ink jet printing
- Compact streamline design.

Suited to the office or home environment. Has ESC/P2. This enhanced printer control language addds scalable fonts & improved graphics capability.

C92110.....$599.00

EPSON EPL- 5200 LASER PRINTER



The EPL-5200 is the latest in Epson's advanced line of laser printers, combining high performance and reliability with a wide range of features. The printer combines a semiconductor laser with the electrophotographic technology used in office copiers to give you high-quality printing that is both fast and quiet. The imaging system used by the printer is driven by a powerful processor that allows the printer to compose an entire page internal in internal memory before printing. The printer can manipulate the page it holds in memory to provide you with many features not found on other types of printers, including the ability to mix text and graphics, create predefined forms, and print with a range of fonts normally associated with typeset material.

C22330.....$1399.00

CTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS

ROD IRVING ELECTRONICS

SAVE! SAVE! SAVE! HUGE PRE SUMMER SOLAR SALE SAVE! SAVE! SAVE!

SOLAR PANELS

SAVE $20

9 Watt Solar Panel

Size: 370 x 370 x 17mm
• 12V Voc 16V (max) 18V
Isc 400mA (ax) 500mA

Z19028...Was ~~$99~~
Now Just $79.00

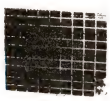
SAVE $30

18 Watt Solar Panel

12V Voc 16V (max) 18V
Isc 800mA (max) 1000mA

Z19036...Was~~$199~~
Now Just $169.00

SAVE $70



27 Watt Solar Panel

12V 16V (max) 18V
Isc 1200mA (max)
1500mA

Z19038.....Was~~$299~~
Now Just $229.00

SOLAR CELLS

ENCAPSULATED SOLAR CELL MODULE 0.45V 200mA

Z19001 Was~~$2.95~~
Now Just $1.95

SAVE $5

SOLAR PANEL 3, 6, 9 VOLT

Simple and easy to use, this solar panel converts the sun's energy to electrical power supply of 3, 4.5, 6 and 9 volts for different electrical appliances. An ideal & conveinient power supply for powering small calculators, radios battery operated toys etc. This product also doubles as a battery charger for "AA" size rechargable batteries

Z19013 Was~~$24.95~~
Now Just 19.95

SOLAR PANEL WITH MULTIPLUG

Provides extra power for your portable radio / cassette player, simple to use, easy and convenient. Clips to your belt or pocket as a solar battery charger for rechargable batteries.

Z19015.....Only.$12.95

SOLAR BATTERY CHARGERS

SAVE $10

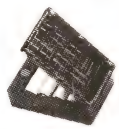
SOLAR CAR BATTERY CHARGER

Never worry about your car battery giong flat when left without being used over a prolong period of time. Simply place the solar power unit on your dash or near a window in your garage and plug it into your car cigarette lighter. The unit consists of solar cells in a housing with 1 metre of cable and cigarette plug.

Z19054 ..Was ~~$29.95~~
Now Just $19.95

SUPER SOLAR CAR BATTERY CHARGER

Z19052.....$69.95



1/2 PRICE

SOLAR BATTERY CHARGER FOR "AA" SIZE BATTERIES

2 Cells & 2AAA cells
Z19050 Was~~$18.95~~
Now Just $9.95

SAVE $10

"C" & "AA" SIZE SOLAR BATTERY CHARGER

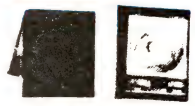
One of the clevereat battery chargers ever made. This battery charger doesn't just charge "C" size batteries it also chargers "AA" batteries Never be without powe again. Great for camping, fishing, boating etc. So compact it can be taken anywhere.

Z19051 Was~~$19.95~~
Now Just $9.95

KEYCHAIN BATTERY ANALYZER FOR TESTING ALL SIZES OF BATTERIES

Z19062.....Only $4.95

SOLAR LIGHTS



SOLAR CAR EMERGENCY LIGHT AN CHARGER

Use this great device as an emergency light/blinker. or as a torch light for repairing your car etc. in the dark. The solar panel can be adjusted to different angles for better absorbsion of sunlight. Can also be used as a straight forward battery charger for for charging rechargable batteries Comes with 2 NC standard rechargable batteries.

Z19053 Was ~~$29.95~~
Now Just $27.95

SOLAR MUSICAL KEYCHAIN WITH LIGHT

Never lose those keys again with this clever little device. The solar powered keychain with light will let you know where you left your keys just by listening for the music. The solar powered light will always let you find that illusive keyhole in the dark.

Z19060.....$4.95

SAVE $20

RECHARGEABLE SOLAR LIGHT

• Automatically turns on at night and turns off during the day.
• Detachable solar panel for indoor or outdoor use. • Unique protection for low voltage discharge ciruitry makes charging easy and quicker!
• Easy to install, equipped witha ccessories for easy asseembly beside the house number, pathway, side of the house, in the garden, sitting room study room etc.
• Speedy Charging - Only 6 hours of charging will give 12hours of use at night. (Depending on location and time of year)

Z19060 Was~~$49.95~~
Now Just $29.95

SOLAR EMERGENCY LIGHT

Never worry about getting caught in the dark when your batteries go flat in your torch. This Solar Rechargeable emergency light stores energy from the sun during the day so that the light can be used during the night.. Great for reading so searching in the car. Ideal for camping, Barbecues etc.

Z19061.....Just $19.95

SOLAR RADIOS

SOLAR MINI FM RADIO

Take this solar FM radio anywhere. It's lightweight & con convenient Can be hooked onto a keychain or clip it onto your belt or clothing. It can be charged off the sun or incandescent light. • Unique feature: This radio is equipped with an external DC jack (3.5mm) for quick recharge and operation during or no light.

Z19069 Was ~~$29.95~~
Sale Price..$24.95

SAVE $20

DYNAMO & SOLAR AM/FM RADIO WITH 4 WAYS POWER BACKUP.

This is the radio that every traveller should have! You will never run out of energy sources for this little radio because it has four different power sources: Solar power, Manual dynamo winding, DC charging, "AA" batteries.

Z19064 was ~~$49.95~~
Sale Price $29.95

SAVE $10

SOLAR AM/FM RADIO KEYCHAIN

Pocket size AM/FM radio with keychain and clip for easy listening anywhere, anytime.Where ever your keys go so does your solar radio.

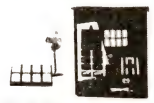
Z19068..Was ~~$29.95~~
SalePrice.....$19.95

SOLAR EDUCATIONAL TOYS

SOLAR MOTOR KIT

This is a great starter kit consisting of a 0.9V 400mA solar cell and a small motor with a 48" wire. Great for beginners or just the curious.

Z19040... Was ~~$9.95~~
Sale Price $7.95



EDUCATIONAL SOLAR ENERGY KIT.

Learn what solar power is and how to build your own solar system. With this great kit you can make an electrical circuit. Learn how to increase voltage, current and how to make a solar panel and produce energy from the sun.

Z19042 Was ~~$22.95~~
Sale Price...$17.95

1/2 PRICE

SOLAR WOODEN MODELS

Build great little solar powered wooden models with these kits! There are 3 different kinds of models to choose from. A helicopter with working motor, an aeroplane with working motor or a gramophone that plays music. Each kit contains a set of precut plywood, PVA cement, assembly instruction sheet, solar cell module, musical IC or small DC motor, wire and sandpaper.

Z19044 Aeroplane
Z19046 Gramophone
Z19048 Helicopter

Were $19.95 Each
Sale Price $9.95 each

SAVE $15

SOLAR VENTILATOR

Specially designed to circulate the air inside your house, apartment, home unit, kitchen, toilet, bedroom etc.
• Ventilate the hot air slowly & smoothly with soft air, not a violent breeze which can untidy & dusty. • Works directly from the sun. Does not need a battery.

Z19055...Was ~~$39.95~~
Sale Price.....$24.95

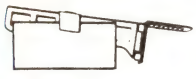
ROD IRVING ELECTRONICS

MASSIVE NOVEMBER SALE NOW ON

COPY HOLDERS

Copy Holder YU-H33
Copy area 9½" x 11"
Sliding line guide
Flat metal base
C21060.....$39.95

Copy Holder YU-H32
Ajustable arm allows easy positioning
*Copy area 9½" x 11"
*Sliding line guide
*Clamping Mounting
C21062.....$39.95

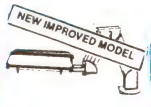


Grip Clip Copy Holder
*Attaches to the top of your monitor
*Spring clip to hold paper.
*Velcro at mount for easy removal.
C21065.....$14.95

MONITOR HOLDERS

Save $50

Monitor Mover Arm
Position your monitor exactly wher you want it
*Maximize your desk space
*Solid steal structure
WAS ~~$199.00~~
C21079..Now $149.00



Save $50

*Sturdy steel construction
*Can rotate 360°
*Lifts monitors up to 22Kg.
*Locks in place with monitor on the tray.
Was ~~$199~~ **Save $50**
C21082.....$149.00

DO YOUR XMAS SHOPPING NOW AND SAVE!

PRINTER RIBBON SALE!

25% DISCOUNT OFF MARKED PRICES. THIS MONTH ONLY!

HERE'S JUST A SMALL SAMPLE OF OUR HUGE RANGE OF PRINTER RIBBONS. WE HAVE OVER 70 MODELS IN STOCK!

Action Printer	**$12.95**
NEC Pinwriter P3	**$17.95**
NEC Pinwriter P5	**$19.95**
Seikosha BP5420	**$19.95**
Citizen 120D	**$10.95**
Epson ERC23	**$18.95**
Epson DFX 5000	**$39.95**
Epson EX 800	**$18.95**
Brother 1824L	**$25.95**
BJ Cartridge BC-01	**$55.00**
Fujitsu DL330	**$18.95**
Tobisha P321/341	**$18.95**
Oki Microline	**$39.95**

PROTECT YOUR DATA WITH A FLOPPY LOCK

Less than half price!

Privacy of documents and personal or company data is very important in todays workplace. Particulally in today's business environment where being one step in front of the opposition is vital for success.
Well now there is a simple and effective way to prevent prying eyes from seeing whats on your floppy disks while your not there. It's called a "Floppy Lock". It's made in the shape of a floppy disk which you simply insert into your floppy drive and turn a key to lock it into place, thus disabling the floppy drive.
It's also ideal for keeping the kids out of your computer! The Floppy drive comes in both 3½" and 5¼" sizes.
3 ½" Lock Was$39.95
C12578....Now $16.95
5 ¼" Lock Was$39.95
C12579....Now $16.95

PAPER SALE

Big Savings

BULK COMPUTER PAPER
Quality paper at a low price!
• 60gsm bond paper
• 11 x 9.5" 2000 sheets
C21001 Was $39.95
Sale Price...$29.95
• 15 x 11" 2000 sheets
C21011 Was 64.95
Sale Price...$49.95

DISK ASSESSORIES

DISK NOTCHER
Converts a 5¼" single sided floppy disk to a double sided floppy by placing an appropriate notch in the floppy disk jacket. **C21070.**
Sale Price.....$6.95

BUY NOW! SAVE HEAPS

HEAD CLEANER DISK
It takes only a minute amount of dust dirt or magnetic oxide particles on your drive heads to cause problems, errors, downtime or an expensive serice call.
Regular use of a head cleaner will keep your drive free of trouble causing dirt and help keep your system up and running. These disk cleaners are simple to use, and include cleaning solution and instructions.
• 3 1/2"
C12560..Was ~~$6.95~~
Sale Price.....$3.95
• 5 1/4"
C12555.. Was ~~$4.95~~
Sale Price.....$3.95

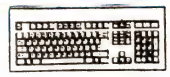
5.25" DISK JACKETS
Protect your 5.25" disks with thesee disk envelopes
Pkt25
C21020.....$1.95

$1.00 OFF

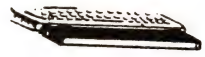
DISK LABELS
(To fit 3.5" disks)
Qty. 30 labels
C21022.....$1.95

DISK LABELS
(To fit 5.25" disks)
Qty. 30 labels & write protect labels
C21021.....$1.95

KEYBOARDS & ACCESSORIES



IBM* COMPATIBLE EXTEMDED "AT" KEYBOARD (101)
X12022.....$45.00



KEYBOARD WRIST REST
This is the product that all secretaries, word processing operators or keyboard operators have been waiting for! The wrist Rest lays in front of the keyboard that allows you to keep your hands at the correct height when typing while preventing fatigue.
C21093.....$9.95

KEYBOARD COVERS
C21089 84 KEYS...$4.50
C21088 101 KEY....$5.95

DUST COVER
These durable & transparent dust covers keep out harmful dust when not in your comptuer or printer is not in use.
*** XT Cover Set**
C21066.....$14.95
*** AT Cover Set**
C21068.....$16.95
*** Mini Tower Cover Set**
C21067.....$12.95
*** Big Tower Cover Set**
C21063.....$14.95
***14" Monitor Dust Cover**
C21061.....$9.95

GENDER CHANGERS ON SPECIAL

SAVE $6

X15690
HD-15P MALE-MALE
X15691
HD-15P MALE-FEMALE
X15692
HD-15P FEMALE-FEMALE
WERE ~~$14.95~~ each
SalePrice Just
$8.95 Each

ANTI GLARE SCREENS
Relieve eye strain and headaches and increase production with these Anti Glare sreens
X99995 12" Screen **$9.95**
X99990 14" Screen **$18.95**
X99991 15" Screen **$59.95**
X99992 17" Screen **$79.95**
X99993 20" Screen **$89.95**

DB9 & DB25 CUT OUT PLATES HALF PRICE!!!

DB25 BACK BRACKET 1 HOLE
P10907..Sale Price $0.95

DB(& DB25 CUT OUT
P10908 Sale Price $0.95

BACK PLATE BLANK
P10909 Sale Price $0.95

COMPUTER CASES

Cases style may vary from illustrations

MINI FLIPTOP TOWER CASE WITH 200W POWER SUPPLY
$95.00

FLIPTOP CASE WITH 200W POWER SUPPLY
$84.00

TOWER CASE WITH 220W POWER SUPPLY
$250.00

VERTICAL COMPUTER STAND
Get your computer on the desk with this vertical computer stand. • Adjustable width from 115-188mm
• Accomodates IBM, PC/XT/AT/ and most compatibles
• Lightweight & Durable
C21076 Was ~~$24.95~~
Sale Price.....$19.95

ROD IRVING ELECTRONICS

NOVEMBER SALE NOW ON

EXCESS STOCK CLEARANCE OF WIRE & CABLE

All prices per 100m roll.

SINGLE CORE MINITURE SHIELDED

Conductor: 1 x 10 strands / 0.8
Shielded: Wrapped copper
Sheath: PVC O.D. 1.3mm

Cat No	R.R.P.	Special price
W11210	~~$30.00~~	$22.00

100m Roll Save $8.00 a roll

LIGHT DUTY 75 OHM COAX

For frequencies under 400MHz

Works fine for T.V. (3C 2V)
Attenuation: 6.2dB / 100ft
Conductor: Copper 0.5mm
Dielectric: Foam P.E.
Shielded: Braided copper
Sheath: O.D. 5.8mm

Cat No	R.R.P.	Special price
W11222	~~$50.00~~	$29.00

100m Roll Save $21.00 a roll

75 OHM AIR SPACED COAX CABLE

Attenuation: 4.3dB / 100ft
Conductor: Copper 1.0mm
Dielectric: Foam P.E.
Shielded: Braided copper
Sheath: O.D. 6.5mm

Cat No	R.R.P.	Special price
W11223	~~$90.00~~	$59.00

100M Roll Save $31.00 a roll

HEAVY DUTY 75 OHM COAX

Must be used for long runs & SBS / UHF TV reception ie for frequencies over 400 MHz (5C 2V)

Attenuation: 3.9dB / 100ft
Conductor: Copper 0.8mm
Dielectric: Foam P.E.
Shielded: Braided copper
Sheath: O.D. 7.5mm

Cat No	R.R.P.	Special price
W11224	~~$75.00~~	$59.00

100M Roll Save $16.00 a roll

HEAVY DUTY 75 OHM COAX

Attenuation: 3.9dB / 100ft
Conductor: Copper 0.65mm
Dielectric: Airspaced P.E.
Shielded: Braided copper
Sheath: O.D. 6.05mm
Colour: Black

Model No: RG62

Cat No	R.R.P.	Special price
W11241	~~$99.00~~	$49.00

100M Roll Save $50.00 a roll

These cables are very heavy & should be picked up from our stores. Extra Pack & Post will be charged to send them mail order.

CRYSTAL SPECIALS

GRAB SOME CRYSTALS FOR YOUR TOOLBOX

		1 - 9	10 +
2.304	MHz	$1.00	$0.75
2.764800	MHz	$1.00	$0.75
3.932160	MHz	$1.00	$0.75
4.433618	MHz	$1.00	$0.75
4.4400	MHz	$1.00	$0.75
4.750	MHz	$1.00	$0.75
4.9562	MHz	$1.00	$0.75
5.000	MHz	$1.00	$0.75
5.068	MHz	$1.00	$0.75
8.867238	MHz	$1.00	$0.75
10.00	MHz	$1.00	$0.75
10.6445	MHz	$1.00	$0.75
14.31818	MHz	$1.00	$0.75
18.0000	MHz	$1.00	$0.75
20.000	MHz	$1.00	$0.75
27.000	MHz	$1.00	$0.75
32.000	MHz	$1.00	$0.75

U - SYNC BUFFER

Provides ten signal outputs with only one P.C. system
*Utility for analog signal input.
*Highly recomended for exehibition and demonstration purposes.
*Minimum video response of 120MHz at 3dB
Display capabilities: 1024 x 768 - 1280 x 1024 resolution
Video Input: Analog (0.7Vp-p)
Frequency band-width:120 MHz at-3dB
Single connector: 9 - 15 pin D - sub connector for analog signals

5 ONLY! just $595.00 each

NOVEMBER SALE

15% off all kits
20% of all plugs & sockets
Stock Up Now!

FANS FANS FANS

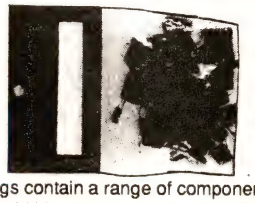
WE HAVE TOO MANY OF THESE

115V 3.5" (88.9mm) 1 - 9 10 +
T12467 **$7.50** **$6.00**

240V 3.5" (88.9mm) 1 - 9 10 +
T12465 **$14.50** **$12.95**

12V (80mm) PLASTIC FAN COMPUTER POWER SUPPLY

1 - 9 10 +
T12462 **$10.50** **$9.00**



$10.00 GRAB BAGS

These grab bags contain a range of components and parts from old kits, including wire and LED's ceramic trimpots from the Service Dept. and old IC's, odd fuses crystals and tantalums.

$20.00 MONSTER BAG

Same components as listed above but heaps more and more value.

RODS VALUES PACKS

ASSORTED VALUE PACKS

• .25W 1% METAL FILM PACK
• Contains: Approx. 250
R19001.....$7.95

• 25W CARBON FILM PACK
• Contains Approx: 250
R19010.....$5.95

• 50V CERAMIC PACK
• Contains Approx. 100
R19020.....$6.95

• POLYESTER CAP PACK
• Contains Approx. 50
R19030.....$6.25

• PBC ELECTRO PACK
• Contains: Approx: 50
R19040.....$6.95

DIODE PACKS

100 per pack
1N4002 (1A 200V Recifier)
Z10103.....$4.95
1N4004 (1A 400V Rectifier)
Z10106.....$5.95
1N4007 (1A 1000V Rectifier)
Z10112.....$6.95
1N914 / 1N4148
Z10135.....$3.95
1N5404 (3Amp 400V)
Z10114.....$12.95

LED MIXED PACKS
(Red only 5mm)
Approx. 100 pieces
Z10138.....$11.95

FUSE PACKS

3AG pack of 40 ($12 Value)
Contains: 4 x 500mA
8 x 1A, 6 x 1.5A, 2 x 2A, 6 x 3A, 4 x 5A, 2 x 7.5A, 4 x 10A.
S15992.....$8.95

M205 Pack of 40 ($12 Value)
Contains: 5 x 500mA, 10 x 1A, 10 x 2A, 5 x 3A, 5 x 5A, 5 x 10A,
S15994.....$8.95

MIXED IC SOCKETS
100 Units ($37.00 Value)
Contains: 15 x 8 pin, 20 x 14 pin, 10 x 16 pin, 10 x 18 pin, 5 x 20 pin, 10 x 22 pin, 5 x 24 pin, 5 x 28 pin, 10 x 40 pin,
P10546.....$24.95

ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS ROD IRVING ELECTRONICS

ROD IRVING ELECTRONICS - WHERE YOUR DOLLAR BUYS MUCH MORE!

SPEAKER PORTING TUBE

ack plastic speaker tubes designed for finishing
breathing or porting outlets on speaker cabinets
28640...Inside dia: 82mm,
ength: 33mm.....$1.95
28635...Inside dia: 51mm,
ength: 65mm.....$1.45

PLASTIC FEET

Plastic Feet for speakers, cases, large kits etc...38cm dia. x 15 cm Pack of four.
H11862.....$3.95

VELCRO TAPE

This tape has so many uses. Perfect for keeping grilles on speaker cabinets, or use it to keep surfaces together that need to frequently come apart and be reattached. Great for kits to keep battery holders in place.
H10504 100mm x 20mm.....$1.45

HUGE SAVINGS ON SOUND BLASTER CARDS

SOUND BLASTER DELUXE II

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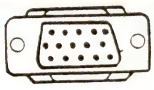

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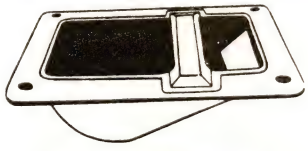

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Australian-designed Unimeter does it all

If you have a workbench or workshop loaded down with test instruments, then you should seriously consider the Australian-designed and built Autoplex Unimeter. It could eliminate a lot of clutter.

Review by DARREN YATES

The Unimeter is just as its name suggests – one instrument that can replace many of the single function pieces that clutter many benches. Not only can it auto-range measure AC and DC volts and current but it has over 100 other functions included which are selected by using the softkeys on the front panel.

Some of these functions include metering for a variety of thermocouples, temperature meters for a number of IC sensors (including the LM35, AD592 and LM135), mains frequency meter, tachometer, period monitor, frequency monitor, up/down counters, low-frequency sine and sawtooth generators, efficiency monitor and so on.

Also available is optional software and a serial adaptor which allow you to feed data from the Unimeter to a standard PC. Thus, you can continuously monitor systems and save the data for later retrieval. You can also display the data graphically on screen for dynamic presentation and professional results. The software is menu driven and allows the user to print out data and screen shots for ha copy storage.

The Unimeter itself is very sma measuring just 150 x 91 x 44mm, ar is designed to sit in a small instr ment rack, the water and dustpro front membrane keeping the instr ment free of foreign matter. Unlik many PC-interface instruments, th Unimeter has a 4.5-digit liquid crysta display as well as the aforementione softkeys.

The Unimeter is a multi-function instrument which interfaces with a PC to give on-screen displays of various measurements. Over 100 functions are accessible via the softkeys on the front panel.

Programming

Two comprehensive manuals explain how the device is programmed and also give programming examples on the RS232-RS485 data transfer protocol. Each function is explained with its own set of specifications so you know exactly what the Unimeter is capable of producing while working on that function.

Easy to follow diagrams show how the front panel of the Unimeter is programmed, as well as how external devices such as the serial interface, flow meters, thermocouples and the LM35 temperature sensor are connected.

Incidentally, an RS232-to-RS485 adaptor is also available, while mounting brackets and the hardware required are provided. Instructions on how to run the software are also included in the manual. This software is quite easy to use and very versatile, with on-screen graphical display of up to four variables available simultaneously.

All inputs and outputs are connected to the back of the meter, leaving an uncluttered front panel which is easy to see and operate.

Part of the design also includes the first QUADAC Quad-Slope Dual Referenced Bi-directional Conversion technique, which gives 14.5-bit con-

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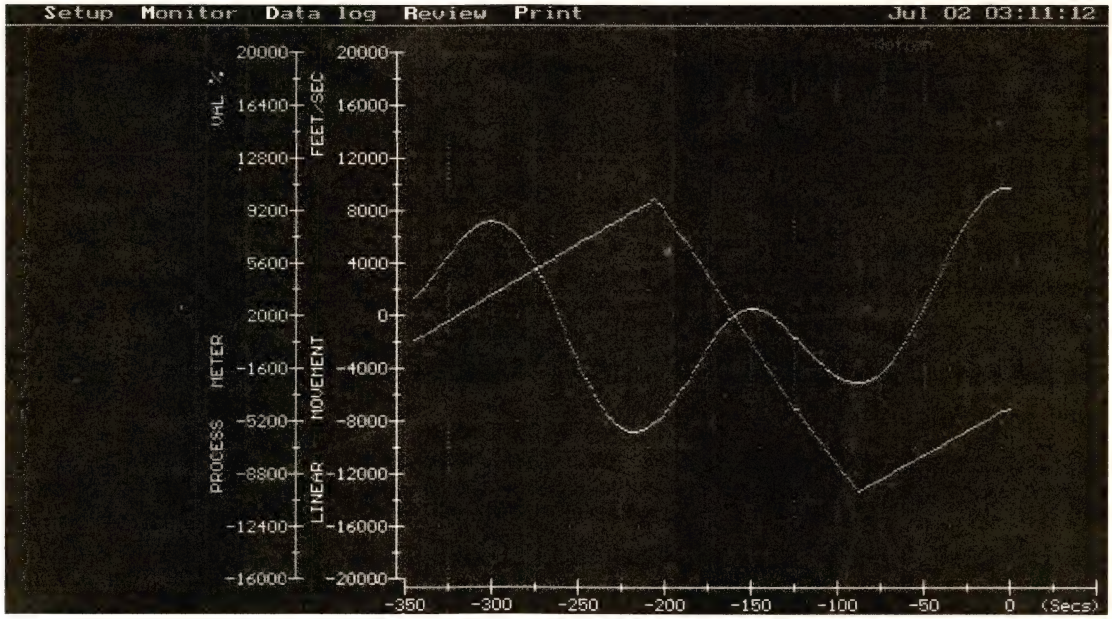

rsion but a resolution of 20 bits. iis gives an overall accuracy of .1% which is very good for an in-ument of this type. Auto calibra-on is performed every 10 seconds to aintain this accuracy and ensure that easurements are spot-on.

This is quite an amazing piece of ear when you consider that all of these functions come inside such a tiny package. It is ideal in most industrial control processes and represents a big step forward in wide-range data acquisition.

One of the great things about the Unimeter is that it is designed and built in Australia and is distributed worldwide by Nilsen Instruments Pty Ltd. The cost of the Unimeter is $490 plus $400 for the optional software. Optional extras including a serial adaptor, a PLC interface and a power supply are also available (prices include sales tax).

For further information, contact Allan Winford at Nilsen Instruments Pty Ltd, phone (03) 419 9999. **SC**

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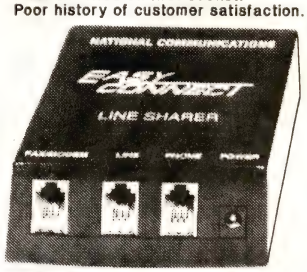

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VINTAGE RADIO

By JOHN HILL

The vexed question of originality

How far should one go to ensure originality when restoring a vintage radio receiver? Often, for all sorts of reasons, non-original parts & materials must be substituted if the set is to be restored to working order.

Way back in the January 1993 issue of SILICON CHIP, the "Mailbag" page carried a letter which severely criticised me for converting a battery-powered receiver to 240V AC operation. Apparently, battery radios must remain battery radios for ever.

I did not bother answering my critic at the time, mainly because of the time lag involved. SILICON CHIP operates on a two-month lead time and any reply would have taken months before it finally reached the newsstands. By that stage, the issue would have long been forgotten.

Since then, however, I have had second thoughts on the matter. Unlike my critic, many other enthusiasts share my viewpoint and they do not insist that originality be maintained at all cost. This month's Vintage Radio will present some of my thoughts on maintaining originality when restoring old radio receivers.

The Historical Radio Society of Australia (HRSA), of which I am a member, puts out a quarterly newsl ter. From time to time, there ha been comments in the newsletter garding the alteration of receivers (conversions and the like) and the S ciety generally does not condone su modifications.

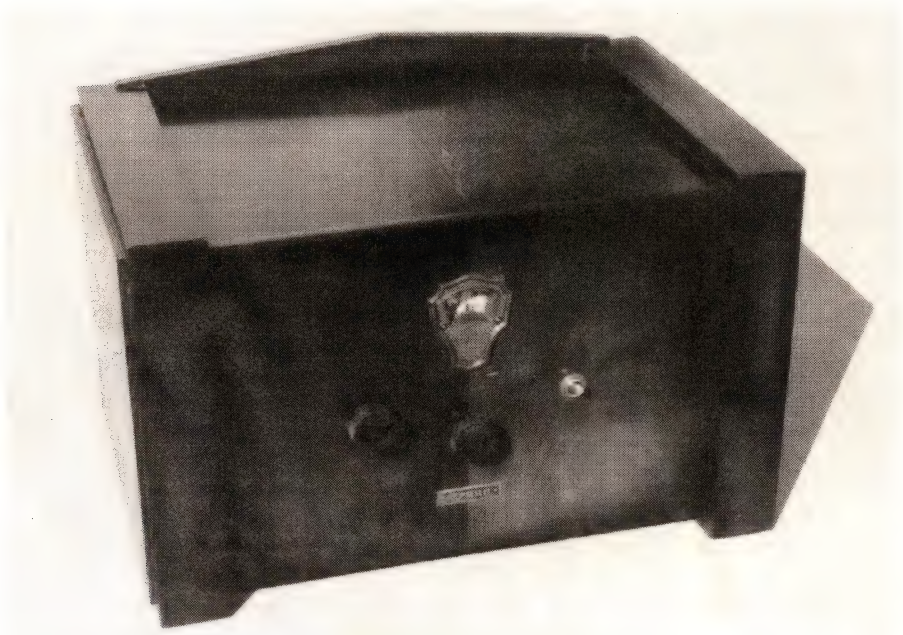
That said, the fact remains that cc lectors are individuals with minds an opinions of their own. If someor wants to convert a battery receiver t 240V, then it really has nothing to d with anyone else.

I know from my own experienc that an AC conversion is an interest ing challenge and mine eventuall proved quite successful once the bug had been ironed out. I also believ that the receiver would be much easie to sell in its present 240V form than i it had been left as a straight battery set, requiring a mountain of batteries or a special power supply to run it. Surely using a specially made modern power supply is departing from the originality aspect just as much as an AC conversion?

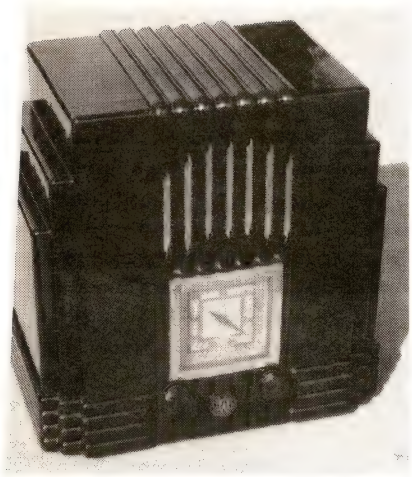
With the set I converted, the chassis was already punched for the rectifier valve and power transformer, so why get uptight about adding these components?

Even though the receiver ended up being quite unoriginal, only someone fairly familiar with that make and model of receiver would notice the difference. The modifications are not very apparent until one looks underneath the chassis, where the wiring and some components are far from authentic. But how many people are going to insist that the chassis be removed from the cabinet for an originality inspection?

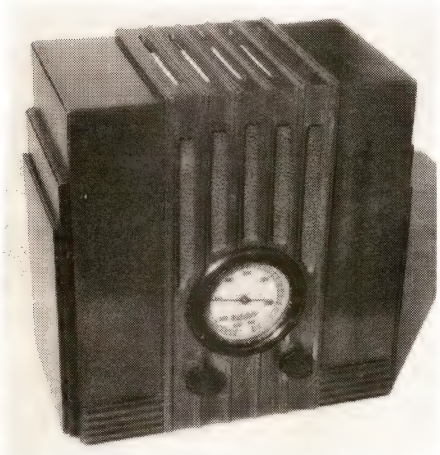
The most critical of the "it must be original" brigade seems to be the older collectors who have been collecting most of their lives. These people have



This 1930 3-valve Seyon was the first reasonably original old receiver the author found. Even then, it had the wrong output valve & its accompanying loudspeaker had long been lost.



ırly AWA Radiolettes with bakelite timber cabinets are very collectable ems. This particular series is often ferred to as the "Empire State" odel, due to the shape of its cabinet. he set shown is very original & ıcludes the correct knobs, badge & peaker cloth. Although the power ord has been replaced, it looks as ıough it could still be the original.



A 1934 timber cabinet Radiolette in very original condition. The major differences between this model and the bakelite "Empire State" version were the round dial &, on later models, the valve shielding.

had the advantage of picking up early radios and spare parts when they were still plentiful and in good condition. That makes keeping them original a much easier task.

Today's collector is faced with an entirely different situation because most of the receivers he finds are – more often than not – total wrecks. If the "keep it original" brigade could see some of the things I have found in various stages of disrepair, they most certainly would not want them as original items in their vintage radio collections.

Amplion horn speaker

A good example of some of these wrecks was described in Vintage Radio for February 1993. In this instance, an Amplion horn speaker was rebuilt from parts that were salvaged from three damaged and incomplete speakers. To make matters worse (from an originality perspective), some of the metal work was re-nickelled and some was repainted, while the timber work was fully refurbished using satin Estapol®. I'll pause now while everyone throws their hands up in horror.

Unoriginal and all as the little Amplion may be, it looks absolutely beautiful. What's more, I have received many a request to sell it, with offers of up to $400 being made to tempt me. Would an unrestored original with crazed lacquer and peeling nickel be more valuable?

I take pride in my restorations and do them to the best of my ability. The restoration of the old Amplion horn speaker required considerable care and a reasonable degree of skill. When such a project is completed, there is a great feeling of achievement. Surely this must be more rewarding than rubbing Marveer® over the original?

Timber cabinets

Very few timber cabinets retain a good surface finish after 50 or more years. In the case of the previously mentioned AC conversion (which involved combining two wrecks), the better of the two cabinets was 90% bare timber with loose veneer. What is one supposed to do – keep it original or refurbish it?

As far as I am concerned there is no choice in the matter. Most timber cabinets require the full restoration treatment if they are to look presentable again. Nothing looks worse than crazed or flaking lacquer – even if the remaining fragments are the remnants of the authentic original finish.

On several occasions in this column, mention has been made of installing modern capacitors inside the cardboard tubes of older paper capacitors. This suggestion was included for the benefit of those who may wish to retain an authentic appearance for the under-chassis components.

Personally, I have never done this and it is most unlikely that I ever will, simply because it seems such a ridiculous waste of time and effort, the result of which will be hidden from view anyway. If ever such a doctored receiver finds itself on my workbench, the first thing I will most likely do is cut out all the old "paper" capacitors.

Power cords

What should be done regarding the use of original power cords? Original power cords may look authentic but, in most cases, the natural rubber used in their manufacture becomes perished and no longer provides a safe level of insulation. One only has to twist some of this old power flex to

Rear view of "Empire State" Radiolette. This 1936 model uses individual valve shields which makes valve replacement easier than the earlier model. This receiver still has its original loudspeaker.

Rear view of the timber cabinet Radiolette. Note the different valve shielding used in this model, compared to the unit in the bakelite cabinet. Apart from that, the two are virtually identical.

hear the brittle rubber insulation cracking. Plastic covered wire may not look the part but it is usually a lot safer than the cord it replaces.

Speaker grille cloth is another originality problem worth discussing. I have seen many restored receivers with tattered, moth-eaten speaker cloths which have been left in place because of originality. Some have even had the holes sewn together which is a fairly obvious repair. Surely some reasonably appropriate replacement material is preferable to a faded, dirty, moth-eaten original?

While on the subject of originality, it is interesting to look through the 1993 Vintage Radio Calendar, keeping in mind that the featured receivers are owned by some of Australia's foremost radio collectors.

The Peter Pan on the front page of the calendar is missing all of the capital city stations that are normally marked in red on the front of the dial. That's not very original, is it?

But who is going to throw the set away because of a few missing stations and who would expect to find the red station markings on the front of the dial when polishing it?

Can you pick out the sets in the calendar that may have the wrong knobs, power cords or non-original speaker cloths? Maybe, maybe not! Regardless of this, the sets in this beautifully presented calendar look the part and that's what really counts.

Old Bill, a collector friend of mine, has quite a few interesting radios from the 1920s. I might add that not one of them is in working order. Wl more, on closer examination, som these sets have had quite major alt tions made to them in the past an are not very authentic at all.

One such receiver is a 6-valve l Michael superhet. It is an impress looking receiver of about 1924-5 v tage. It must be that old because it v originally made to receive the lo wave hand which was in use fo short period of time before gene broadcasting switched to what is n commonly called the AM or broa cast band.

The authenticity of the old M Michael has been sadly ruined due some serviceman's modification hand-wound aerial coil on a cardboa former), so that the receiver could tu into the "new" broadcast band whic came into existence sometime in th mid 1920s.

What should be done with such receiver? Leave it with an "authenti modification" or convert it back to th long-wave band with further non original circuit alterations? How ex treme do you wish to be regardin originality?

Originality vs practicality

Now readers should not think that I am one-eyed or anti-original. I am not but I do like to think that I am reasonably practical. In fact, there are a number of receivers in my collection that are very original, although they are few and far between.

These receivers were in exceptional condition for their age when I acquired them and I have tried to maintain their original appearance. Some still retain their original speaker cloths and cabinet finish, while the chassis have only been cleaned and polished, not repainted. They also have the right shaped valves and, generally speaking, look the part.

I can appreciate the value of such sets but if I only collected these "good ones", then I would have a very small collection indeed. As for the remainder of my radios, most were found in quite poor condition and I have either restored them, combined them with other similar models, or converted them to 240V operation as I saw fit at the time.

The veteran and vintage car people probably have similar discussions about originality. I imagine that if they strove for complete originality there

Another popular Radiolette model from the author's collection. It's not quite as original as the models featured on the previous page. The speaker cloth has been replaced & its chassis is in only fair condition due to surface rust.

d be very few old cars in working
r and those that were would be
, smoke-belching rattle traps.
ound out many years ago when
ing a Skoda 1200 station wagon
of six in Australia) that, with
ifications – Austin pistons, an
timing chain and a Holden car-
ettor – it worked quite well. When
bonnet was down, no-one would
e ever known the difference.
ıcidentally, the Skoda was given
ne – that was the only way its
vious owner could get rid of it.
er six years, I eventually gave it
ay too.

While improvisation can keep many old car or radio receiver in working ler, keeping them completely origi- l is another matter. Originality is a e ideal but a fairly unrealistic one most instances.

If an old valve radio is 100% origi- l, then there is every chance that it es not work. If it is working, it has ost likely had some of its parts re- aced at some time or other and is, erefore, no longer original. As stated efore, it depends on what extremes ıe wishes to go to regarding this ıatter.

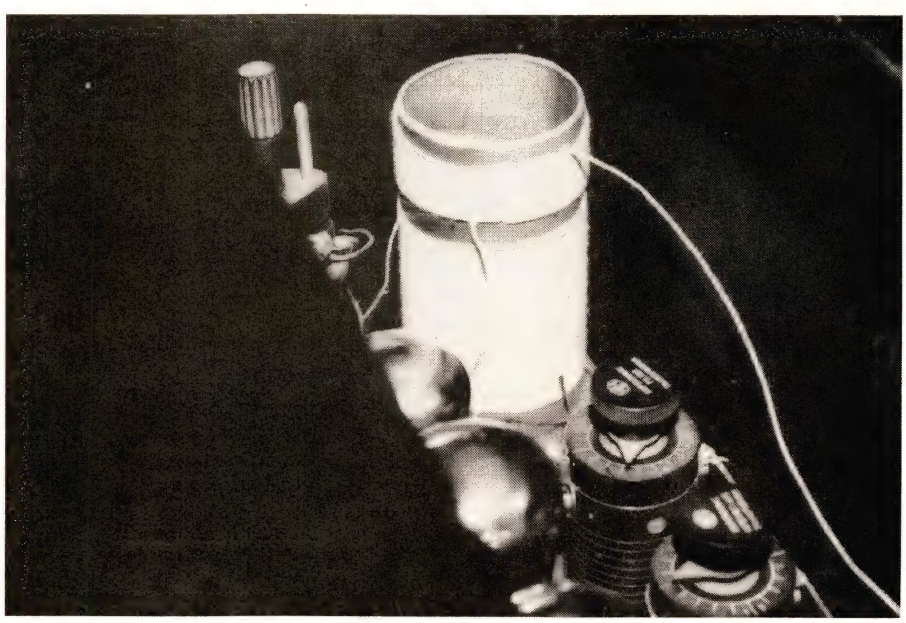
Some would argue that there are arying degrees of originality: com- letely original, very original, fairly riginal, not very original and fairly ıoriginal. No doubt you can add a ew more categories to this list. It all lepends on what parts are available ınd how much money one is pre- ɔared to spend restoring a receiver.

From my point of view, I enjoy my ınvolvement with vintage radio. I like to get old receivers working again without spending more on the project than it is worth. I think that this is where some collectors lose sight of reality because when the time comes to sell some of their wares, they cannot get back what they have spent.

When all is said and done, they are only old radio receivers that, until a few years ago, were being discarded in great numbers because no-one wanted them. Now, for some reason or other (so I am told), they should be maintained in their original condition. Well, I don't think that that is being very realistic and I for one will continue to do my own thing as I see fit!

No doubt, some readers will wholeheartedly support what I have written in this story, while others will completely disagree. Normally, I am not so outspoken about such matters, preferring to let others do as they wish without my interference. Hopefully, others will view my activities in a similar manner.

This view shows the old McMichael Super-Seven superhet receiver that was mentioned in the text. While the receiver looks fairly genuine on the outside, a major modification to the aerial circuit has spoilt the set's originality.

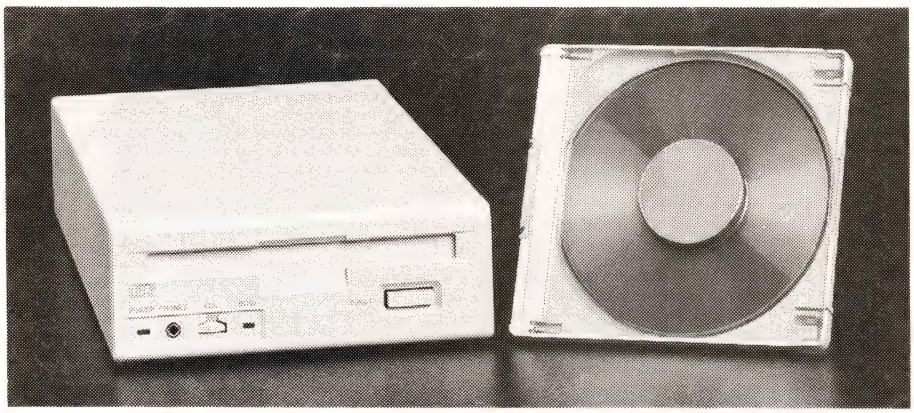


This close-up view shows the hand-wound aerial coil that was used to convert the McMichael receiver to broadcast band reception (the set was originally made to receive the long-wave band). Note the two IF transformers sitting next to the home-made coil.

However, I was challenged about the wilful destruction of two "authentic" battery powered radios. After considerable deliberation, this has been my reply. I hope that I have not offended too many of my readers.

On to more important matters next month. **SC**

PRODUCT SHOWCASE



Panasonic CD-ROMs now available

Panasonic expects that its CD-ROM disk drives will capture a significant percentage of the rapidly growing CD-ROM market in Australia. The range comprises several models, all featuring fast access times of 290ms. They are available in AT-BUS or SCSI formats and can be built-in or standalone. Panasonic currently employs a caddy system but it expects to release tray-type CD-ROMs later this year.

The biggest seller of the current range is the CR-522-B internal AT-BUS drive. It can be easily installed into a spare 5¼-inch floppy disc bay. It is connected from the power supply and a 40 wire cable runs to either the controller card or directly to the sound card.

The CR-522-S is designed as a stand-alone unit, for those situations where a computer's power supply is inadequate to support another peripheral. It has a 64K buffer. For applications where more than one CD-ROM drive is required, Panasonic markets the model CR-501 which allows up to seven drives to be linked together in a daisy chain.

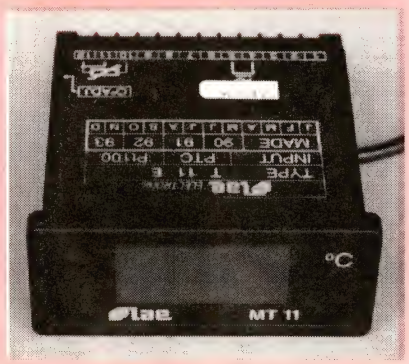
External SCSI model, the Panasonic CR-501-S, has a separate power supply as well as the ability to da chain other devices. This drive, wl has a 64K buffer, is mainly inten for Apple Macintosh users becau: can be plugged straight into tl standard SCSI port and it's read: go.

For further information, cont Multimedia Technology on (03) 8 7105 or Panasonic Australia on (986 7400.

Giant digital bargraph display

Amalgamated Instrument Co. has announced the release of a new extra large digital bargraph display. Designated the model LD4-574BG, it features high visibility and high brightness 57mm LED digits which are readable from at least 25 metres away.

The LD4-574BG is suitable for monitoring any industrial variable where a graphical representation as well as a digital display is required. Strain gauge, pressure transducers and load cells, 4-20mA, 0-1 volt, 0-10 volts, BCD, binary and frequency make up part of the large range of input types



available. Analog input models are available with an inbuilt alarm relay output.

For further information on this product contact Amalgamated Instrument Company, phone (02) 476 2244.

Low cost frequency synthesizer

Capable of ultra-wide frequen synthesis, the FSC-30 and 50 are h length cards for any PC-XT/AT/3 and provide one or to two indepen ent TTL level programmable squa wave generators, at low cost.

Both models come with one or tw synthesisers per card, with each cha nel being independent of the othe and crystal controlled for excelle stability. An optional external refe ence input is also available, with re erence source then being jumpe selectable between external or o board frequency source.

Software supplied with the card provides either command line or pop up menu selection of output fre quency. Driver software is also sup plied, with source code, for writing custom programs and an example program is included.

The FSC-30 has a range of 0.024Hz to 30MHz while the FSC-50 has a range of 2.98Hz to 50MHz, with resolution for both being 27,000 steps per decade. The cards have three switchable addresses, for multiple card use, and are connected via 50Ω coax with BNC connectors.

For further information, contact Boston Technology Pty Ltd, PO Box 1750, North Sydney, NSW 2060. Phone (02) 955 4765.

Scratch remover for compact discs

Harald Schmid, an inventor in Ludwigsburg, Germany, has produced a kit that allows the removal of scratches

compact discs by grinding down a portion of the ide plastic shell with a specially designed sand- er. It sounds like a fiendish thing to do but it is ned to work.

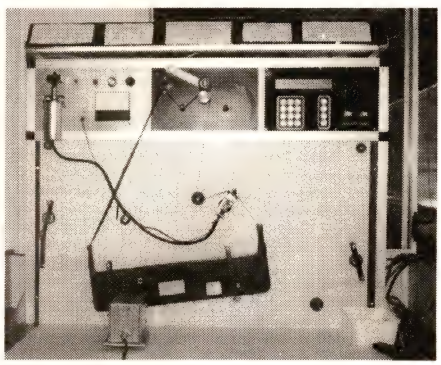
espite claims that compact discs never wear like l plastic records, scratches on the disc's transparent ing can interfere with the process of reading the rded data. The result is that damaged or scratched s can cause players to mistrack, mute or skip.

everal companies have begun marketing disc repair that usually include polishing and cleaning materi- Mr. Schmid's kit goes a step further by including eral grades of sandpaper and guidelines for removing n fairly deep scratches.

Trackmate Australia Pty Ltd, manufacturer of audio, leo and computer care products, is distributing the CD pair kit in Australia. Suggested retail price of the ackmate CD repair kit is $29.95 and it is available at all ndy stores and selected hifi retailers.

For further information, contact Trackmate Australia y Ltd on (02) 973 1807.

e-inking ervice or printer ibbons



Inverell Technology Centre as introduced its new ultra high speed fabric ribbon re-inking machine. Up to now it has not been possible to accurately re-ink ribbon cartridges and these would usually be thrown away. Utilising microcomputer technology, the new system can accurately re-ink the majority of fabric ribbons of any physical shape or size at speeds of up to one metre per second with ink densities accurately controlled.

A single joystick controls all major functions of the machine to allow single-handed operation. The direction of ribbon travel is automatically sensed and set, thus completely eliminating the need to set up motor directions.

With this type of system, the most delicate ribbon cartridge may be inked as easily as the largest type available. Once the speed and pressure settings of a particular type of cartridge are decided, they can be saved in a memory and instantly recalled later on. Single colour ribbons can be inked as successfully as black ribbons, and bulk rolls may be inked with an optional roll carrier.

The machine can re-ink almost all dot matrix fabric printer ribbons typically at a cost of $4.50 to $9.50. Some very large ribbons are up to $30.00 each. As a general guide, ribbons are 40% of the new retail price. Quantity discounts for bulk orders are applicable and freight is free both ways for orders over $45.00. Ribbons in lots of 10 may be sent post free to Inverell Technology Centre, Reply Paid 22, 86-88 Ring St, Inverell, NSW 2360. Phone or fax 067 21 0200.

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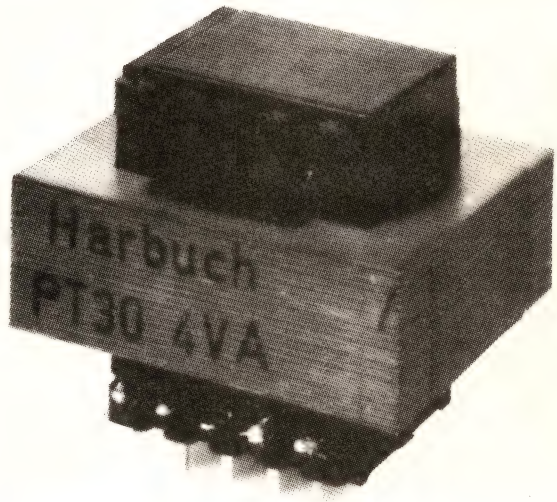

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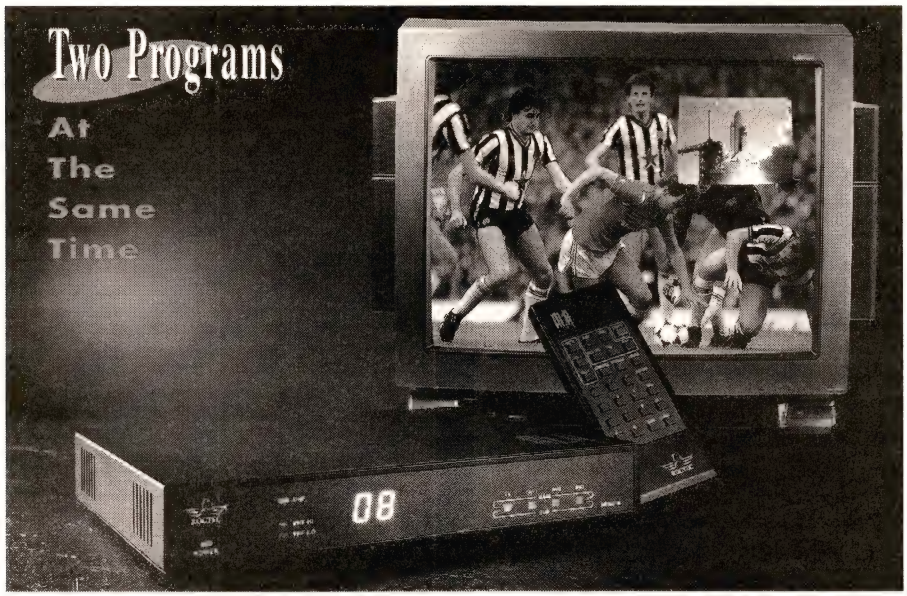


Picture in picture adaptor

Have you ever wanted to monitor your favourite satellite channel whilst watching commercial TV? Now there is a way of doing it. The Dynalink picture in a picture decoder allows you to view commercial TV whilst monitoring your favourite satellite channel, by superimposing the satellite picture in any corner of your TV screen. When something interesting comes on your satellite channel, you just press the SWAP button and the two pictures are transposed, allowing you to view your satellite channel, whilst now monitoring the commercial channel.

The Dynalink picture in a picture decoder comes with its own remote control unit, has an inbuilt TV tuner and output modulator, and has three video and audio inputs. The PIP channel has its own audio output, which can be fed directly into your hifi system. Of course, the unit can be also used for two commercial channels, by using the inbuilt PIP tuner and present VCR as the second tuner, feeding the VCR video into one of PIP video inputs.

The Dynalink PIP decoder, wil available, initially in limited qua ties, at $595. Cat # T1800.

For further information contact Comm Pty Ltd, PO Box 225, Balg lah, NSW 2093. Phone (02) 949 7 or fax (02) 949 7095.

TOPFET devices from Philips

With the introduction of the BU 105-50L/S, Philips Semiconduct has extended their 3-pin TOPF (Temperature and Overload Protect Field Effect Transistor) range with pin versions.

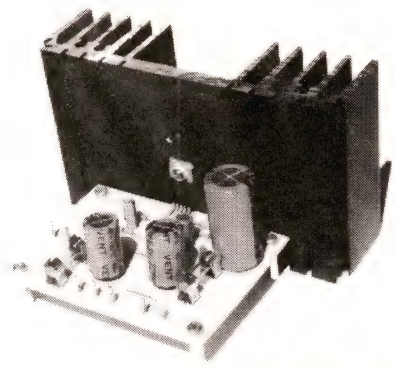
This second generation can be use as a general purpose switch for lamp motors, heaters and solenoids in a tomotive and other 12-volt syste where protection of the switch an fault condition notification are re quired. In addition to switched opera tion, the BUK105- 50L/S can be use in linear mode, without loss of pro tection.

The BUK105 can protect itself fron over temperature, caused by overloa or shorted load, and from overvoltag transients. An over temperature wil

Coming next month* in SILICON CHIP

25 watt hifi amplifier module

This neat little amplifier module uses just one monolithic power chip in a five-lead package to deliver 20 watts RMS into 4Ω or 25 watts into an 8Ω load. The module can be built to suit single or dual supplies and it is protected against short circuits and overloads. It has surprisingly good performance figures and the overall component count is low.



You could use it to replace the amplifier modules in an old amplifier or as the basis for new equipment.

Build an AC impedance meter

Also to be featured in the coming December issue is an AC impedance meter especially designed for PA system installers. It can be used to test transformers, 70V and 100V PA lines and resistors. It has three ranges and a digital display.

Stroboscope for speed measurement

Most readers are familiar with strobe lamps in discos and with the stroboscopes used to measure the speed of rotating machinery. This design eliminates the dangerous high voltage supply required for the Xenon discharge tube. Instead, it uses a brace of high brightness LEDs for the strobe light and a simple power supply.

*** Although these articles are planned for publication, unforeseen circumstances may change the final content. On sale, 24th November.**

a latch in the device which sets lag and can turn off the MOSFET ischarging the gate.

he latch will remain tripped until reset by means of the protection ply pin. An overvoltage transient l cause an off-state device to be ıed on, clamping the voltage to a ; level.

'he new device has a vertical power :OS output stage which features a v on-state drain-source resistance 05Ω, a continuous drain current of amps (120 amps peak) and a total wer dissipation of 75 watts.

For further information contact .ilips Components, 34 Waterloo Rd, ɔrth Ryde, NSW 2113. Phone (02) ɔ5 4455.

'isual Basic oftware

Azonic, republisher for Merlin Delopment Pty Ltd, has announced OWRRR Chart/VB, an Australian deeloped software for Microsoft Visual ;asic developers. POWRRR Chart/VB ives the Visual Basic developer acess to charting and presentation graphics capabilities.

Included in the software is stylesheet based charting, a file manager/ viewer, a complete illustration package for annotation of charts and hundreds of ClipArt samples to assist the Visual Basic developer to produce a professional package.

POWRRR Chart/VB requires Windows 3.1, Visual Basic 2.0 or higher, a 386 computer or higher, VGA graphics or higher, 4Mb RAM, 4Mb available disc space and a mouse.

Orders can be placed now at an introductory price of $295 from Azonic Pty Ltd. Phone (02) 878 4444.

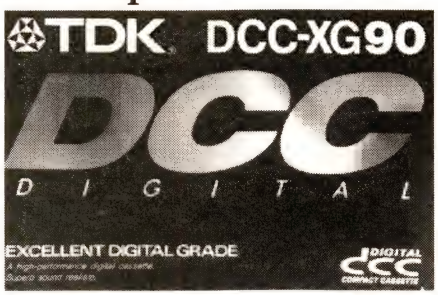
Education directory on CD-ROM

Acorn Computers has released the fourth edition of its education directory. Over 2000 educational titles are listed. This allows the user to browse through the data files, searching for key words or companies, or particular types of software.

By keying buttons on the display, the user gains access to linked pages of information which may contain screen shots, demonstation versions of the software, or further information on particular packages.

The CD-ROM version of the directory is available free of charge to schools, directly from Acorn. For further information, contact Peter Revell, Acorn Computers Australia Pty Ltd, 12 Gipps St, Collingwood, Vic 3066. Phone (03) 419 3033.

TDK announces DCC tapes



TDK has announced the release of their DCC tape to the Australian market. Available in two record/playback times, DCC-XG60 (60 minute) and DCC-XG90 (90 minute), the tapes are priced at $13.95 and $15.95 respectively. For further information and the address of your nearest TDK dealer, ring (02) 437 5100. **SC**

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May 1992: Build A Telephone Intercom; Low-Cost Electronic Doorbell; Battery Eliminator For Personal Players; Infrared Remote Control For Model Railroads, Pt.2; A Look At Large Screen High Resolution Monitors; OS2 Is Really Here; Aligning Vintage Radio Receivers, Pt.2.

June 1992: Multi-Station Headset Intercom, Pt.1; Video Switcher For Camcorders & VCRs; Infrared Remote Control For Model Railroads, Pt.3; 15-Watt 12-240V Inverter; What's New In Oscilloscopes?; A Look At Hard Disc Drives.

July 1992: Build A Nicad Battery Discharger; 8-Station Automatic Sprinkler Timer; Portable 12V SLA Battery Charger; Off-Hook Timer For Telephones; Multi-Station Headset Intercom, Pt.2.

August 1992: Build An Automatic SLA Battery Charger; Miniature 1.5V To 9V DC Converter; Dummy Load Box For Large Audio Amplifiers; Internal Combustion Engines For Model Aircraft; Troubleshooting Vintage Radio Receivers.

September 1992: Multi-Sector Home Burglar Alarm; The Interphone Digital Telephone Exchange, Pt.2; General-Purpose 3½-Digit LCD Panel Meter; Track Tester For Model Railroads; Build A Relative Field Strength Meter.

October 1992: 2kW 24VDC To 240VAC Sinewave Inverter; Multi-Sector Home Burglar Alarm, Pt.2; Mini Amplifier For Personal Stereos; Electronically Regulated Battery Charger (Charges 6V, 12V & 24V Lead-Acid Batteries).

November 1992: MAL-4 Microcontroller Board, Pt.1; Simple FM Radio Receiver; Infrared Night Viewer; Speed Controller For Electric Models, Pt.1; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.2; Automatic Nicad Battery Discharger.

December 1992: Diesel Sound Simulator For Model Railroads; Easy-To-Build UHF Remote Switch; MAL-4 Microcontroller Board, Pt.2; Speed Controller For Electric Models, Pt.2; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.3; Index To Volume 5.

January 1993: Peerless PSK60/2 2-Way Hifi Loudspeakers; Flea-Power AM Radio Transmitter; High Intensity LED Flasher For Bicycles; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.4; Speed Controller For Electric Models, Pt.3.

February 1993: Three Simple Projects For Model Railroads; A Low Fuel Indicator For Your Car; Audio Level/VU Meter With LED Readout; Build An Electronic Cockroach; MAL-4 Microcontroller Board, Pt.3; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.5; File Backups With LHA & PKZIP.

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September 1993: Automatic Nicad Battery Charger/Discharger; Stereo Preamplifier With IR Remote Control, Pt.1; In-Circuit Transistor Tester; A +5V to ±15V DC Converter; Remote-Controlled Electronic Cockroach; Restoring An Old Valve Tester; Servicing An R/C Transmitter, Pt.1.

October 1993: Courtesy Light Switch-Off Timer For Cars; FM Wireless Microphone For Musicians; Stereo Preamplifier With IR Remote Control, Pt.2; Electronic Engine Management, Pt.1; Mini Disc Is Here; Programming The Motorola 68HC705C8 Microcontroller – Lesson 2; Servicing An R/C Transmitter, Pt.2.

PLEASE NOTE: all issues from November 1987 to August 1988, plus October 1988, January, February & August 1989, and May 1990 are now sold out. All other issues are presently in stock, although stocks are low for some older issues. For readers wanting articles from sold-out issues, we can supply photostat copies (or tearsheets) at $6.00 per article (incl. p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge.

ASK SILICON CHIP

Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a lin and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097.

Give the transformer a fair go

I recently constructed the Universal Power Supply Board described in the August 1988 issue of SILICON CHIP. I used the Dick Smith M2856 transformer which has a multi-tapped secondary (giving 30V centre-tapped or 36V centre-tapped – Editor). I connected the 0V from the transformer to 0V on the board, 15V from the transformer to 30V on the board and the other 15V winding to 15V CT on the board.

I tested the output voltages from the circuit board and obtained +15V on that output but no negative voltage, then after several minutes, I had no voltage and the transformer became very hot. I took it out of circuit and found the primary winding open circuit. I returned it and obtained a replacement. It was assumed the transformer was faulty. I tested the replacement before placing it into circuit and obtained all the correct voltages.

I then connected it to the circuit and the same thing happened. Surely not another faulty transformer? I checked the circuit and components and could not find any faults. Suddenly it dawned on me! I should have connected the transformer outputs to the circuit board as follows: 0V to the position marked CT 15V on the board; one 15V to the 30V position on the board and the other 15V tap to the 0V on the board.

Even considering this to be the correct way, I do not see how connecting it the way I did would cause the primary coil to overheat. The only thing I had connected to the output of the circuit board was my multimeter to test for correct voltages. Therefore there was not any excessive current being drawn from the secondary coil. Can you offer any explanation. (W. C., Adamstown Heights, NSW).

• From your description, it appears as though you have placed a direct short circuit across one of the 15V windings of the transformer. That is why it became very hot and eventually burnt out the primary winding. Your alternative method of connection appears to be correct and should not cause any problems. The way to test these things is as you proceeded in the first place. Apply power, measure the voltages and, if conditions are not correct, switch off and check for faults.

Big power supply for model motors

I am interested in the circuit on page 93 of the July 1993 issue, showing how to increase the output of terminal regulator. I have a nee supply power to small motors as i in model aeroplanes, with short t test currents of up to about 35 an Your circuit with two transistor said to be capable of delivering up or 9 amps. Therefore, since TIP2995 has a current rating of 15 should be able to add two more T 2995s in parallel to easily suppl current of 35 amps for a short tim

The power source will be a 12V battery, which will limit the outpu bit by the drop across the TIP299 voltage control may be lost after abo 9.5 or 10 volts, just so long as t output is not limited to that voltag

2N3055s may work better, due their better heatsinking although t circuit would have to be changed suit NPN transistors. I would be usi an LM317 to achieve a "soft star with a pot in place of resistor "R (refer to the circuit on page 210 of th DSE catalog), a meter across the ou put for volts & a series meter for amp I have suitable digital meters.

Your comments on this or a bette way to achieve a soft start and contro for test periods of a few seconds onl will be appreciated. The test is t change the prop, switch on, run the volts up to the "cell equivalent" (6, 7 8 or 10) read the current and the tacho then shut down.

The amp/hour capacity of my car battery is more than 50 times that of the nicad flight pack I will subsequently be using. Hence, volts and current will be much more stable and the battery will not require recharging after only a few minutes of testing various propellers. (R. F., Laura, SA).

• Essentially, your idea is workable except that we would be inclined to use five or six TIP2995s in parallel in order to be able to handle the current. The LM317 is not suitable since it would not be able to supply the required base current for the power transistors. You will need to upgrade to an LM350 adjustable regulator which can supply 3A. You will need massive

Problem with the Walkaround Throttle

I have built the Walkaround Throttle Controller; ie, the pulse width modulated circuit described in April and May 1988 issues of SILICON CHIP. My problem is that it has lost the minimum setting for the throttle. I can adjust the maximum voltage setting via trimpot VR1, however the minimum trimpot VR2 makes no difference and the throttle fades to zero volts by half-way; ie, from 0-50% on the throttle there is 0V, and from 50-100% throttle it goes from 0V to 12V.

Can you help me with this problem as it affects slow starting by taking an eternity to reach halfway before it starts to move. It also seems to have too much inertia. (G. H., Lambton, NSW).

• The fault with the minimum speed setting is likely to involve op amp IC1b which buffers trimpot VR2. This op amp is shorted or dead. Check for shorted tracks or replace the op amp package.

sinking for the power transistors, cularly if you want to have a soft , because this will cause very high er dissipation.

to 12V inverter nted for a VW

own a 1965 Volkswagen which is ning on a 6V system. The battery harged by a 6V generator. My ques- is do you know of any circuitry t will convert 6V to 12V DC with a rent capability of around 10 amps ich I could use to power an ampli- r. (R. C., Glen Iris, Vic).

Unfortunately, we do not have a -12V DC converter. However, it may possible to adapt the circuitry of e 12V SLA battery charger described the July 1992 issue. You would ed to modify the output transistors d the switching inductors to boost e output to 10A.

low to measure power output

Congratulations on a fine magazine. am very enthusiastic about electron- s as a hobby and maybe a career. Now for a few questions: how do you neasure the RMS output power of an mplifier? Is it necessary to buy or nake watt meters?

I am using the ETI-1430 power amplifier with the preamplifier from the Studio Twin Fifty amplifier (described in March & April 1992). Is it possible to increase the power by paralleling the output transistors? Also, I have heard mention of "bridging" two amplifiers together for increased power. How is this done?

Has SILICON CHIP ever described a digital AM/FM tuner? I know you did an AM tuner but I am in need of AM and FM. When a tuner has "synthesised" stereo sound (FM), does that mean it uses the true stereo broadcast (signified by the 19kHz carrier?) or does it generate its own pseudo stereo? In short, if I transmitted a song on the left channel only, would the synthesised FM tuner play a song on the left channel only as well? (J. P., Teralba, NSW).

• The method of measuring RMS power output of an amplifier is as follows. You need a resistive load with a power rating greater than the amplifier to be measured and with a value of 8Ω (or whatever the rated impedance is. We refer to this as a "dummy" load. Second, you need to apply a sinewave signal to the amplifier. This signal normally comes from an audio oscillator. You then measure the RMS voltage at the output at just before the onset of clipping (you need an oscilloscope to judge this point). It is then simply a matter of calculating the power using the formula: $P = V^2/R$.

Increasing the power output of an amplifier cannot simply be done by paralleling the output transistors. If you did this without increasing the supply voltage you will get no power increase at all – in fact you may get slightly less. Secondly, the BC546 used as a driver transistor would not be able to supply the extra base current to the paralleled output transistors. Hence to really increase the power output of an amplifier you need to increase the supply voltage, the power supply capability and the number of output transistors. You will need bigger driver transistors as well. It really amounts to a complete re-design of the power amplifier.

Bridging entails the use of two mono amplifiers which are driven with out-of-phase input signals. Each power amplifier drives one side of the speaker load and, therefore, their voltages add, hence the power output is quadrupled, in theory. In practice, the increase is somewhat less.

SILICON CHIP has not described a digital AM/FM tuner and since these units are relatively cheap, we are not likely to describe such a constructional project. The term "synthesised" refers to the use of a frequency synthesiser to control the local oscillator frequency. In fact `synthesised' really means the same thing as the term "digital" when referring to AM/FM tuners. Any synthesised FM stereo tuner produces true stereo reception.

Even bigger inverters wanted

I would like to propose the following solar based projects, to capitalise on those done by SILICON CHIP so far:

(1) A step up/step down battery charger circuit that can regulate up to one kilowatt of solar panels, in three versions: 12V, 24V and 48V. For example, a basic circuit with a different component list for each version. Have the circuit adjustable for the different

Problem with digital voltmeter kit

I have recently completed the digital voltmeter kit for cars/boats/solar and, as happens from time to time, the thing refused to work., Actually, as far as I am concerned, this isn't a bad thing as it makes me find out just how the particular circuit works instead of just wielding a soldering iron whilst listening to the radio. This one was particularly stubborn and, after checking everything about six times without finding a fault I decided one of the ICs must be on the blink. I am always loathe to reach this conclusion but, for once, I was correct and on replacing the BCD counter (MC14553) I got readings instead of a row of noughts.

However, I still had a problem. The unit took about a minute to give a stable reading and, until then, hunted a couple of volts on either side. When it settled it was quite accurate but, as I wanted to use it to check three banks of batteries (on a boat) it was not entirely satisfactory. Incidentally, the MC-14553 was the last one I replaced – I've changed the other three ICs as well.

Finally, for want of something else to do, I finished the digital voltmeter kit by fastening the two PC boards together, back to back. I then fired it up again and, to my considerable surprise (and pleasure), the thing worked without hunting. Apart from a vague thought about a capacitive effect, I am rather baffled. Can you throw any light on the matter? (M. F., Frenchs Forest, NSW).

• We are am pleased to know that you have got the project to work and suggest that there was probably some radiation of hash from the 4049 inverter chip into the op amp circuitry and this may have caused the hunting that you observed.

Electronic cockroach not light sensitive

I am a Year 10 student at Kotara High School in Newcastle, currently studying electronics. For my Year 10 major work I have elected to construct the electronic cockroach which you featured in your February 1993 edition.

However, on completion of the project, I find that it does not work correctly; ie, the level of light falling on the LDRs has no effect on the speed of the motors.

The motors do work and their speed can be adjusted using the trimpots. I was unable to purchase Johnson 170 motors and have used Mabuchi FA-130 instead. I was unable to purchase BD646 PNP Darlington transistors and was advised by Novacastrian Electronics that the BD650 was equivalent – these have been used. All other components are as specified.

Using a multimeter, I only get an increase of about 2kΩ across the LDRs when they are covered. Is the DSCDO1 from Dick Smith Electronics the same as an ORP12 LDR? Examination by my teacher using a CRO revealed highs and lows where he expected them to be. Could you please offer some assistance to locate the fault? (S. H., Newcastle, NSW)

• First, we hope you have not misunderstood what the motors are supposed to do with changes in light level. The motors either will run at the speed set by trimpots VR1 and VR2 or they will be stopped, depending on the light falling on the LDRs. The motor speed is not set by the LDRs.

This is how it works. When LDR1 is exposed to bright light, pin 10 of IC1c will go lower than the pin 11 input and motor M1 will run. Conversely, when LDR1 is in shadow, pin 10 of IC1c will be higher than pin 11 and the output, pin 13, of IC1c will go low to prevent pin 6 of IC1a from going high. The motor will therefore stop.

A similar process occurs with motor M2 and LDR3.

You should be able to get th circuit going with the DSCD0 LDRs and this is how you can se up the circuit. You will need t measure the voltage across eacl LDR when the same amount o light is applied to each device Check that the voltage across each one is about the same. For the motors to run, the voltage across LDR2 must be higher than the voltages across LDR1 and LDR2. This happens when LDR2 has less light on it than LDR1 and LDR3. You may need to alter the value of the 1.2kΩ pull-up resistor for LDR2, to obtain satisfactory results.

Under normal lighting conditions, the voltage across the LDRs should be about 1.5V. You may need to alter the values of the pull-up resistors (the 1kΩ and 1.2kΩ resistors) for each LDR to obtain this voltage. If the voltage across each LDR is too low (below 1.5V) use a smaller value of pull-up resistance. Alternatively, if the voltages are too high (above 1.5V) use larger value pull-up resistors.

full charge voltages of deep cycle and normal lead acid batteries. A typical household solar set up could have 10 or more 75 watt panels, (ie, 750 watts or more).

(2) An article explaining the basic operation of solar panels and regulators. For example, at a solar panel dealer I was told that they only sell normal regulators that shut off once the batteries are charged because shunt circuits waste too much energy. I think they are selling high-priced inefficient low technology to uninformed consumers. However, until an impartial, comparison is published, the consumer will remain uninformed. Also can solar panels be damaged if they are exposed to bright sunlight with no load applied to their terminals?

(3) A five kilowatt sinewave inverter in 24V and 48V versions.

(4) An article explaining how to calculate the practical starting wattage of an induction motor from its running wattage. For example, I have a 240V AC water pump rated at 1.9A, (ie, 456 watts maximum). Its practical starting wattage could be as high as 2.2kW (for a few nanoseconds). If this value was correct I would require a 600 watt inverter which has a 2.3kW maximum intermittent rating instead of a 480 watt inverter which only has a 1kW maximum intermittent rating. How do you calculate this practical starting wattage?

I would also like to see some data and articles on wind generators. (B. B., St Andrews, NSW).

• We are afraid that your proposed solar panel setup with up to 1kW of panels is not practical at all. For example, if you are using a 12V version you would have to control up to 83 amps. As you can see, controlling such a huge current is not a trivial matter. It is much better to connect solar panels in series to a battery bank of 32V, 48V or higher so that the currents are manageable.

Solar panels are not damaged if exposed to bright sunlight with no load applied. In fact, it is very difficult to damage them electrically in any way, even with short circuited loads. They are really only susceptible to mechanical damage, such as from hail.

The same comment about practicality applies to your suggestion for a 5kW sinewave inverter. For example, a version operating from 24V would require an input current somewhere in the vicinity of 250 amps. Our 2kW sinewave inverter described in the latter half of 1992 had an input current of 100 amps or more and this really does present major engineering problems.

It is not possible to calculate the starting current of an induction motor. You need to know the type of motor and its rating, the type of load and the point at which the voltage is applied. Typically though, an induction motor will draw some 10 to 15 times its normal load current at switch on. This surge current can last half a second or more, depending on how long it takes for the motor to reach full speed.

There is also the question of its starting winding and how much current it draws. As you can see, designing an inverter to drive an induction motor means that a very large surge capability must be incorporated. SC

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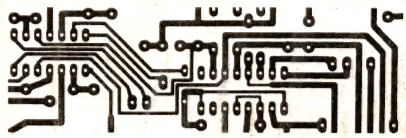

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PRINTED CIRCUIT BOARDS for the hobbyist. For service & enquiries contact: T. A. Mowles (08) 326 5590.

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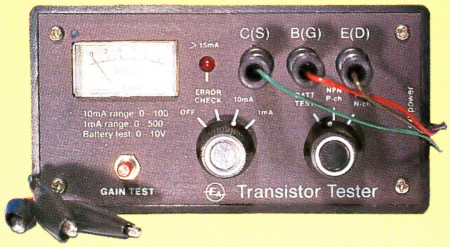

Suitable for testing bipolar transistors, diodes, F.E.T.s, S.C.R.s and P.U.T.s. Comes with a meter, case, silk-screened pre-punched front panel and all components. Requires 9V battery.
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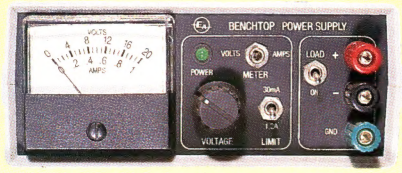
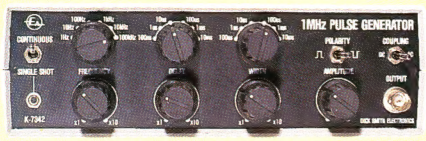


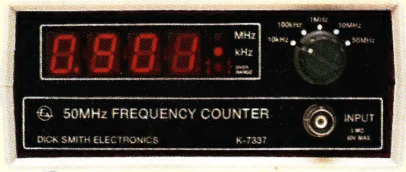
A versatile power supply which gives 2.5 to 18V variable output, switchable current limiting (30mA & 1.2A). Supplied with PCB, all components, case and pre-punched, silk-screened front panel.
Cat K-3202 EA Aug '91 **$79.95**

Pulse Generator Kit



Ideal for evaluating wideband amplifiers and filters. Has a frequency range of 1Hz to 1MHz, single-shot, adjustable delay on the main output and variable output pulses from 1V to 10V. A full-form kit with all components, hardware, pre-punched screened front panel and a deluxe case.
Cat K-7342 EA MAY '92 **$89.95**

50MHz Frequency Counter



High-accuracy/low-cost 50MHz frequency counter. Comes complete with all components, PCB, hardware LED display, case, plug pack & a pre-punched silk screened front panel.
Cat K-7337 EA Feb '93 **$119**

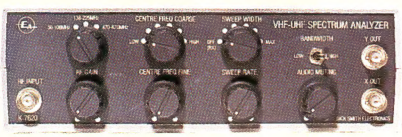
Noise & Distortion Meter

Can measure distortion levels down to less than 0.01% at spot frequencies of 100Hz, 1KHz and 10KHz. Comes with all components including hardware, panel meter and deluxe case with pre-punched silk-screen panel.
Cat K-7222 EA May '93 **$129**

1GHz Frequency Counter

Its design includes a seven-digit display with KHz/MHz status indicator and a frequency range selector (i.e: 2MHz, 20MHz, 50MHz and 1GHz). The kit includes case, PCB, all components, hardware and front panel. Cat K-7604 EA April '93 **$159**

VHF/UHF Spectrum Analyser



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